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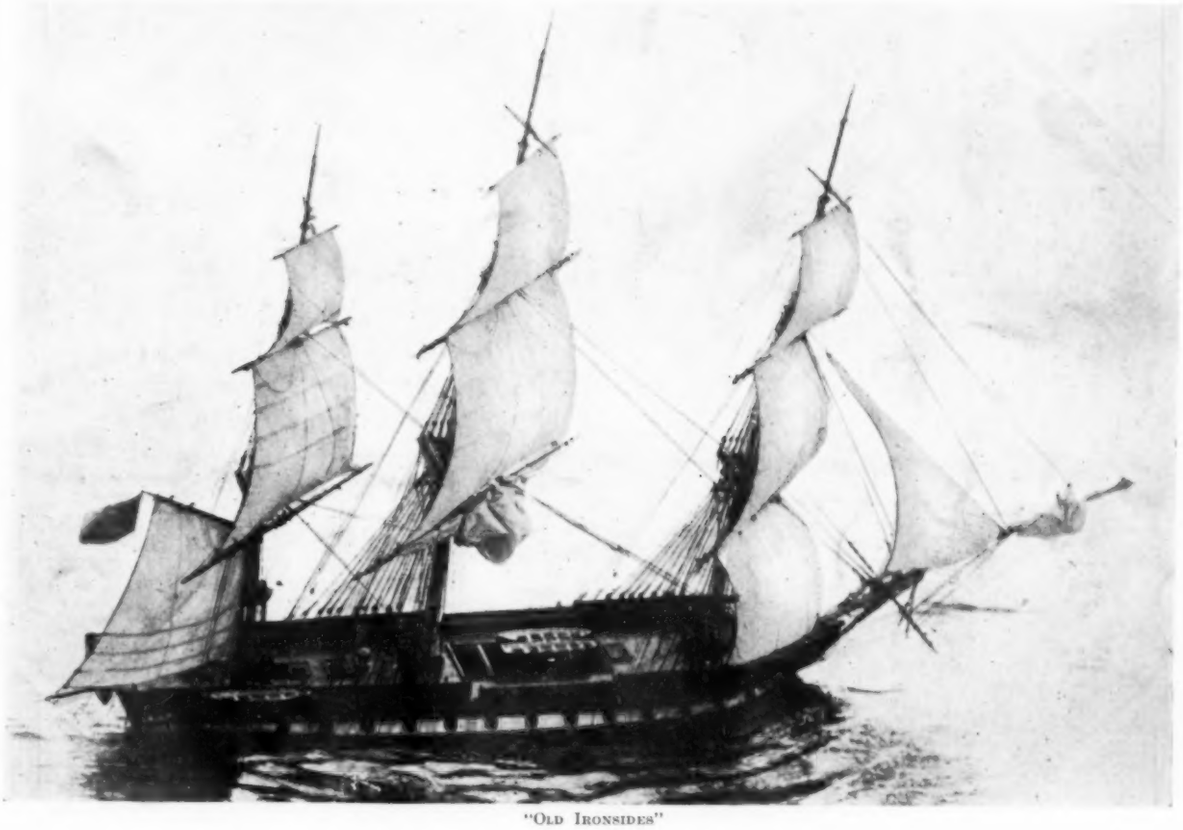
ARMY ORDNANCE

VOL. VI WASHINGTON, D. C., NOVEMBER-DECEMBER, 1925 No. 33



"Old Ironsides"

THE BATTERY OF "OLD IRONSIDES"
Capt. Elliott Snow (C. C.), U. S. N.

THE WAR DEPARTMENT BUDGET
Maj. Gen. Kenzie W. Walker, Chief of Finance, U. S. A.

ECONOMICS OF NATIONAL DEFENSE
Col. James L. Walsh, Ord. Res.

MACHINE TOOLS AND MUNITIONS
Maj. R. H. Somers, Ord. Dept., U. S. A.

ECONOMIC FACTORS IN THE MANUFACTURE OF CONFEDERATE ORDNANCE
Kathleen Bruce, Ph. D.

THE SEVENTH ANNUAL MEETING OF THE ARMY ORDNANCE ASSOCIATION

THE JOURNAL OF THE ARMY ORDNANCE ASSOCIATION

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ARMY ORDNANCE

THE JOURNAL OF THE ARMY ORDNANCE ASSOCIATION

Pledged to Public Service in Effecting Industrial Preparedness for War as Our Strongest Guarantee of Peace

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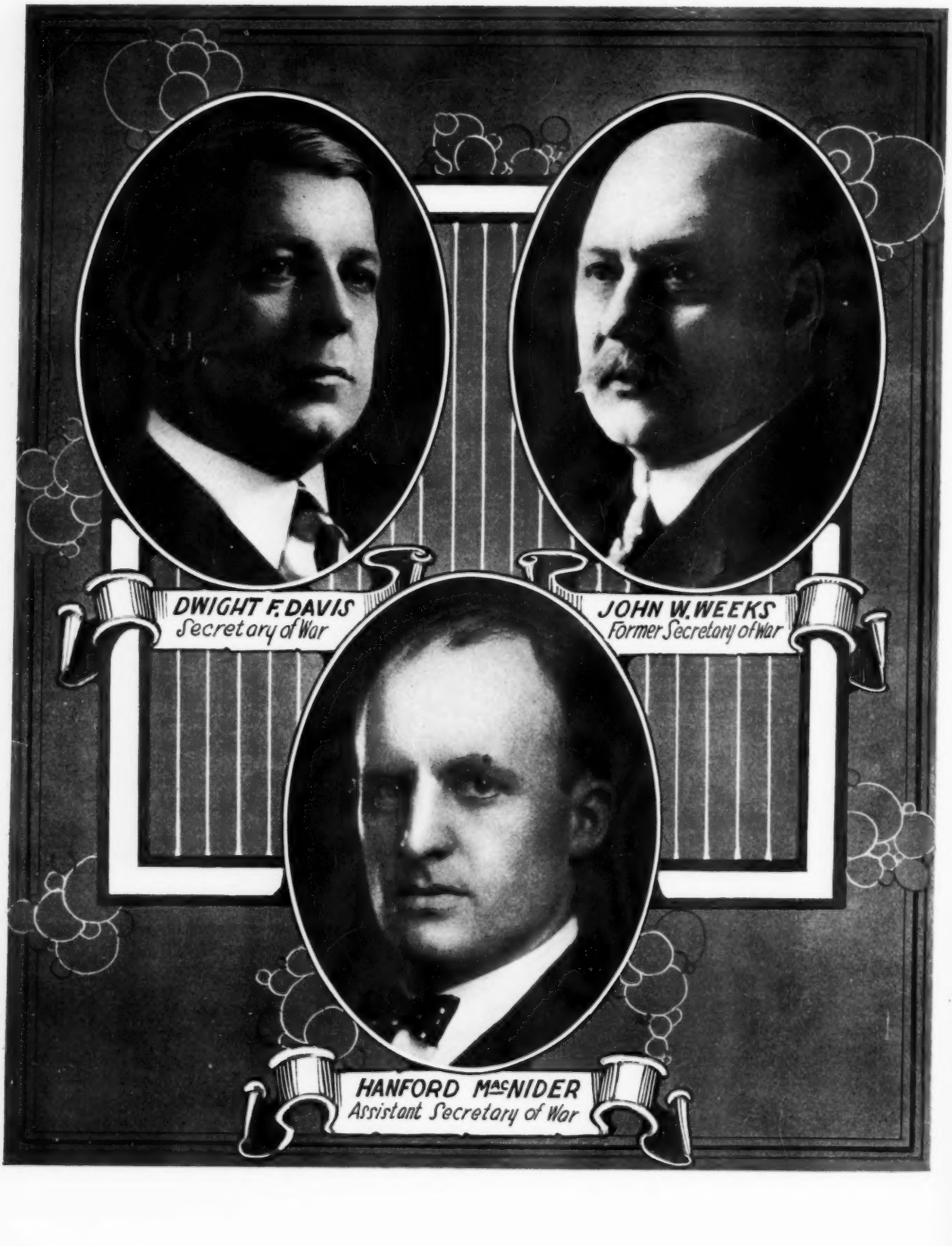

DWIGHT F. DAVIS
Secretary of War
JOHN W. WEEKS
Former Secretary of War
HANFORD MacNIDER
Assistant Secretary of War

Secretary of War Weeks Resigns Dwight F. Davis His Successor Colonel McNider Appointed Assistant Secretary

TO THE regret of the entire Army and the nation, Hon. John Wingate Weeks, Secretary of War since 1921, resigned because of ill health October 13, 1925.

Born at Lancaster, New Hampshire, April 11, 1860, Secretary Weeks was graduated from the U. S. Naval Academy, a member of the now famous Class of 1881. He served in the Navy until 1883, when he resigned to return to civil life. A member of the Naval Brigade for ten years, he served in the Volunteer Navy during the Spanish-American War. In 1913 he was elected to the U. S. Senate, where he served with distinction until March, 1919. Two years later, March, 1921, he was appointed Secretary of War. Secretary Weeks' conduct of his office merited the high esteem in which he is held everywhere. His friends, both in and out of the Army, all wish for him a speedy return to good health.

IMMEDIATELY following the retirement of Secretary Weeks, President Coolidge announced the appointment of Col. Dwight F. Davis as Secretary of War. A graduate of Harvard, Secretary Davis has had a brilliant military career. On September 1, 1917, he accepted a commission as Captain, Company L, 5th Missouri Infantry. On April 10, 1918, he was appointed Major, National Guard. On October 10, 1918, he became Lieutenant Colonel and served as Assistant Chief of Staff, G-3, 35th Division, and Assistant Chief of Staff, G-3, Second Army, American Expeditionary Forces. He is a graduate of the General Service College at Langres. He served overseas from April 25, 1918, to April 20, 1919.

ARMY ORDNANCE takes this opportunity to congratulate Col. Davis on his well-merited promotion. His unusual executive ability has been demonstrated both in the capacity of Assistant Secretary of War for two years and as Acting Secretary since last April during the illness of Mr. Weeks.

Mr. Davis is especially well qualified to operate the War Department on an economic and business basis. He has studiously devoted himself to the cause of industrial preparedness and to the supervision of current procurement of the Supply Branches, and consequently has a keen insight into the business affairs of the Army.

Few members of the President's cabinet have on their entrance been so well equipped for their tasks. In point of fact, Mr. Davis' sportsmanlike practice of the principles of tolerance, justice and fair play, his foresight in anticipating, averting, and surmounting difficulties has served to inculcate these doctrines more firmly in the entire program of our national defense. Never before has there been established more cordial relations between the General Staff of the Army and the Office of the Assistant Secretary of War. In large measure Mr. Davis was personally instrumental in bringing about this harmonious coöperation. He is directly responsible for the foundation of the Army Industrial College, an institution which bids fair to attain the high status in industrial strategy that the Army War College has reached in military strategy.

The splendid war record of Mr. Davis brought him well merited recognition. He was twice cited in divisional orders for gallantry in action and is possessor of the Distinguished Service Cross, the citation for which reads, as follows:

"For extraordinary heroism in action between Baulny and Chaudron Farm, France, September 29-30, 1918. After exposure to severe shelling and machine-gun fire for three days, during which time he displayed rare courage and devotion to duty, Major Davis, then Adjutant 69th Infantry Brigade, voluntarily, and in the face of intense enemy machine-gun and artillery fire, proceeded to various points in his brigade sector, assisted in reorganizing positions, and in replacing units of the brigade, this self-imposed duty necessitating continued exposure to concentrated enemy fire. On September 30, 1918, learning that a strong counter-attack had been launched by the enemy against Baulny Ridge, and was progressing successfully, he voluntarily organized such special duty men as could be found, and with them, rushed forward to reinforce the line under attack, exposing himself with such coolness and great courage that his conduct inspired the troops in this crisis and enabled them to hold on in the face of vastly superior numbers."

The new Secretary of War is a strong advocate of the principle of *one* Army, his interest extending fully to the National Guard and the Organized Reserves. By many addresses throughout the States he has rendered commendable service in enlightening our people in their responsibilities to flag and country. Through untiring efforts he has done much to incite universal interest in the common cause of national security particularly in the business world. He has spread far and wide the doctrine of sane preparedness as our most economic guarantee of peace, and of the necessity for providing for the defense of all the people by all the people. Thus, his strenuous work and high attributes have won for him not only the loyal support of the Army but also the respect and substantial backing of the Nation as a whole.

ARMY ORDNANCE takes special pleasure therefore in congratulating the nation on its good fortune in having

as Secretary of War another experienced leader of recognized ability admirably equipped to accomplish a properly balanced program of industrial preparedness and manpower preparedness on a equitable and efficient basis.

COLONEL DAVIS has been succeeded as Assistant Secretary of War by Col. Hanford MacNider, former Commander of the American Legion.

Colonel MacNider was born at Mason City, Iowa, October 2, 1889. Upon his graduation from Harvard in 1911, he became associated with the First National Bank of Mason City, Iowa, of which institution he later became president. As a Lieutenant in the Iowa National Guard, he saw service on the Mexican Border, and in 1917 entered the Reserve Officers' Training Camp at Fort Snelling, Minn. He served overseas from September 7, 1917, until September 8, 1919, during which time he was instructor in the Army Candidates School, A. E. F., and later Regimental Adjutant and Operations Officer of the 9th Infantry. He was commissioned Captain, July 12, 1918; Major, October 9, 1918; and was assigned as Adjutant to the Second Division, December 27, 1918. On May 6, 1919, he was promoted to Lieutenant Colonel.

Colonel MacNider participated in the battles of Chateau-Thierry, the Soissons counter-offensive, St. Mihiel, Blanc Mont, Meuse-Argonne, and was with the Army of Occupation, Germany. He was awarded the Distinguished Service Cross with the following citation:

"For extraordinary heroism in action near Medéah Farm, France, October 3-9, 1918. He voluntarily joined an attacking battalion on October 3rd, and accompanied it to its final objectives. During the second attack on the same day he acted as a runner through heavy artillery and machine-gun fire. He visited the lines both night and day, where the fighting was most severe. When higher authority could not be reached, he assumed responsibilities and gave the necessary orders to stabilize serious situations. When new and untried troops took up the attack, he joined their forward elements, determined the enemy points of resistance by personal reconnaissance, uncovered enemy machine-gun nests, and supervised their destruction.

"Capt. MacNider is also awarded an oak-leaf cluster, to be worn with Distinguished Service Cross, for the following act of extraordinary heroism in action near Remenauville, France, September 12, 1918: On duty as regimental adjutant, while carrying instructions to the assaulting lines, he found the line unable to advance and being disorganized by a heavy machine-gun fire. Running forward in the face of the fire, this officer captured a German machine gun, drove off the crew, reorganized the line on that flank, and thereby enabled the advance to continue."

Colonel MacNider was also awarded the French Croix de Guerre with palm and the Italian Croce al Merito di Guerra. He served as Department Commander for the Iowa American Legion 1920-21, and on November 2, 1921, was elected National Commander.

In his appointment to the important office of Assistant Secretary of War, friends of industrial preparedness see a most auspicious event. The office of the Assistant Secretary is charged primarily with the weighty responsibility of keeping the country prepared industrially, and Colonel MacNider's excellent civil experience added to his noteworthy military record admirably equip him for this important role.

The Army Ordnance Association takes this occasion to renew its assurance to the new Secretary and Assistant Secretary of War of full coöperation in all matters concerning industrial preparedness.

"I am especially reluctant to leave the War Department at this time. With a Regular Army of twelve thousand officers and a hundred and twenty-five thousand men, a National Guard force of one hundred and seventy-five thousand men, a reserve of more than ninety thousand officers, the annual citizens' military training camps of between thirty and forty thousand men and the Reserve Officers' Training Corps, it is not to be expected that there will be unanimous agreement as to the policies of the War Department. There may be room for legitimate criticism, but, on the whole, this great force has worked together as a unit and during my incumbency I can say that they have worked together most harmoniously. I believe that under the Defense Act of 1920 the Army of the United States has made the greatest advance in its history and has never been more efficient or more prepared for immediate and effective expansion to meet the requirements of war. I take this opportunity to publicly express my gratitude to General Pershing, General Hines and the other officers who have been instrumental in developing the one-army plan and who have so loyally supported my administration of the Department. I have every confidence that a fair investigation of the army will demonstrate its efficiency and preparedness."

(*From the farewell statement of former Secretary of War Hon. John N. Weeks*)

The Battery of "Old Ironsides"

By

Capt. Elliot Snow (C. C.), U. S. N.

(*Copyright*, 1925)

"HISTORY repeats itself," and this being admitted, we should all take heart and *believe* that before many more years run their course, "Old Ironsides" will once again have partaken of the elixir of life. Such a life draught for the Frigate CONSTITUTION can take but one form—a draft on the Treasury of the United States for funds sufficient to restore her "as far as may be practicable, to her original condition but not for active service"; unless funds are donated by her admirers in the Navy and out of it.

The 68th Congress, in an act approved March 4, 1925, authorized the restoration of this vessel but *without appropriating any money for the purpose*. This act carried with it the following proviso:

> "Provided, That the Secretary of the Navy is further authorized to accept and use any donations or contributions *which may be offered for the aforesaid purpose.*"

It so happened on February 14th—St. Valentine's day—1900 an analogous enactment was effected. In this case, however, the funds were to be raised through the agency of the Massachusetts State Society, United Daughters of 1812. After waiting some five years, Congress yielded to public opinion, and included a *mandatory provision* in the Construction and Repair appropriation act to expend $100,000 or such portion thereof as may be necessary to repair the CONSTITUTION.

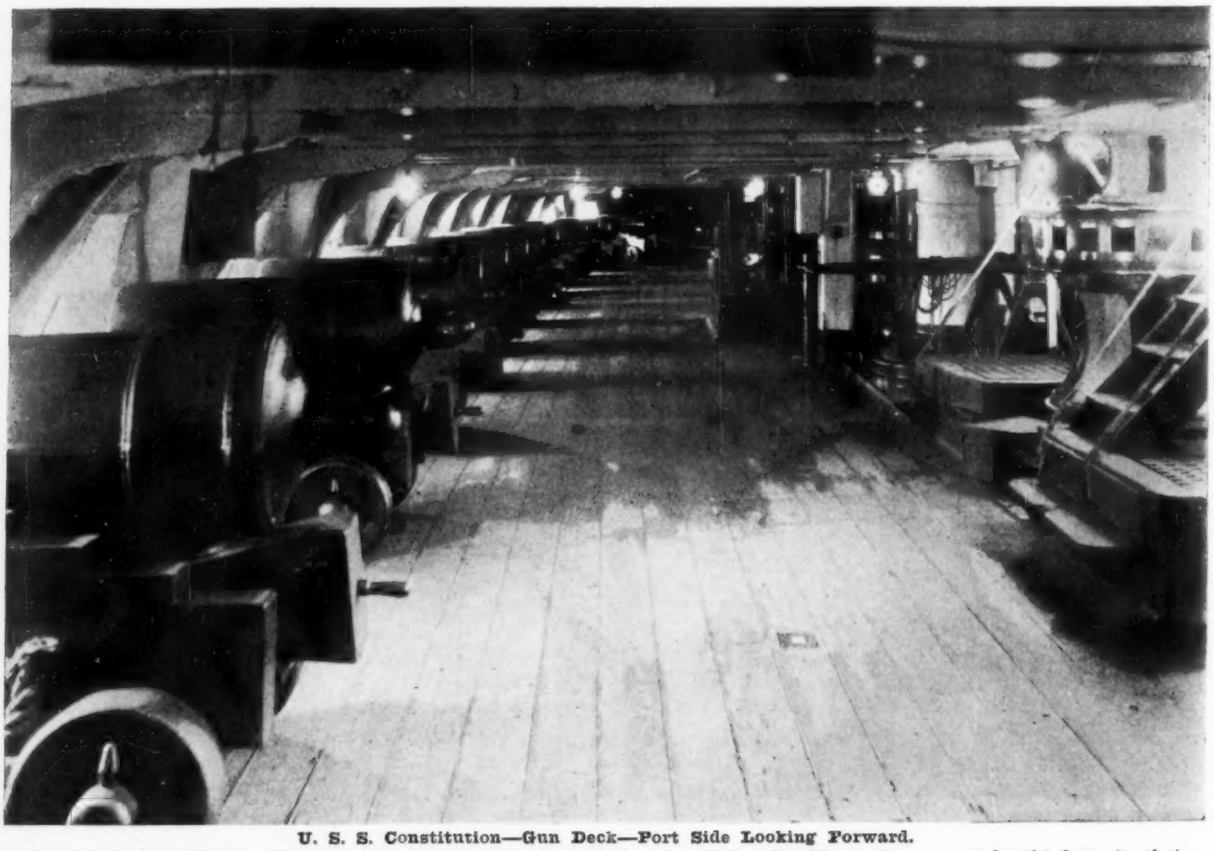
Every day that passes now brings evidence of widespread and growing interest in the historic ship.

U. S. S. Constitution—Spar Deck Looking Aft.

The sixteen 32-pdrs. on the after part of the spar deck, called the quarter deck, are shown. The elevated frame work in the foreground, amidships, from which a bell is suspended is a modern addition, to give alarm in case of fire.

U. S. S. Constitution—The Spar Deck Looking Forward.

The CONSTITUTION carried eight 32-pdrs. on the forecastle here shown. In addition to the guns, the view shows the heavy standing rigging, and shrouds, which stay the foremast.



U. S. S. Constitution—Gun Deck—Port Side Looking Forward.

On this deck "Old Ironsides" carried fifteen 24-pdrs. on each side—30 in all. Her gallant crew fought here in their bare feet, trousers rolled up to the knee, and with the decks wet down.

One bit of evidence came from Duluth, Minnesota, in the shape of a letter to the *Scientific American*, which was commented on by that periodical in its issue of September, 1925, in these words:

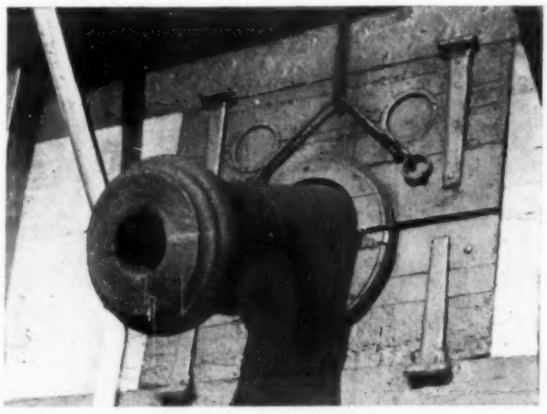
"Rebuilding the Constitution—A Suggestion

Our daily mail bag brings the gratifying assurance that our appeal for funds to rebuild the CONSTITUTION has awakened a widespread and very intelligent interest. From far Duluth comes a valuable criticism of the existing battery as mounted on the CONSTITUTION today. It consists of 54 heavy 24-pounders. This, of course, does not correctly represent the original battery. The CONSTITUTION, when she fought the GUERRIERE mounted thirty long 24-pounders on the gun deck; and on the quarter-deck and forecastle two long 24-pounders, one long 18-pounder and twenty-two 32-pounder carronades. A long "24" weighs about 4,750 pounds; but the carronade was a short light gun of large bore, designed mainly to fire case shot or shrapnel at close range.

When the CONSTITUTION was reconditioned in 1906, the Government found one of her old 24-pounders; and for convenience they cast 54 guns from that pattern. Our correspondent, Mr. Edwin B. Eddy, Jr., suggests two reasons why the ship should be armed as in 1812: first, for the sake of historical accuracy and, secondly, because the change to the lighter carronade would relieve the vessel of from 57,000 to 68,000 pounds of weight, thus easing the stresses and giving her a better chance to remain true to line and form as the years pass by. In this connection we wish to mention that in reconstructing "Old Ironsides," every bit of the timber of the ship of 1812 that remains in her (and there is some of the original oak still in place) and is still in a sound condition, will be religiously retained and built into the reconstruction of 1926." (See "Our Point of View," *Scientific American*, September, 1925, page 156.)

U. S. S. Constitution—General View of the Spar Deck From Aft.

The spar which rests on the chases of the guns on the starboard side (right hand in the view) is the spanker boom which has been temporarily unshipped. This is not a customary stowage for it.



U. S. S. Constitution.

A 24-pdr. pokes its muzzle through a gun port as if it still meant business. The lower half of the port hinges down, the upper half is hauled up by the lanyard.

In the hope of reaching the originator of this suggestion through the columns of the *Scientific American* — a letter addressed to him was returned "unclaimed"—and for the purpose of placing before its readers some first-hand information bearing upon the history of the restoration of the battery of "Old Ironsides," a letter was sent to the Editor Emeritus, and with it was an enclosure which said:

"The suggestion of Mr. Edwin B. Eddy of Duluth, to the effect that during the coming reconstruction of "Old Ironsides," with funds now being raised by popular subscription, the battery carried in

U. S. S. Constitution—The Hull Viewed From Broad Off The Port Bow.

The grim gun deck battery shows up well in this view; also the anchor with its cable laid hawser. The bow scroll and hair brackets (ornamental scrolls) are not replicas of those of 1812.

1812 be provided, is an excellent one. It is to be hoped that the funds *and the information as to the details of the battery she carried in* 1812 *will both be available.* If he can and will write to me or the Commandant of the Navy Yard, Boston, and tell us *where* to find the information upon which to reproduce the battery he will have served his country well—better perhaps, from an historic standpoint than he realizes.

"The restoration of this vessel in 1906, was carried out under my direct and personal control, so that, in so far as my memory now serves me correctly, the readers of the *Scientific American* will here be given the benefit of first-hand information regarding the factors which controlled the design of the battery now carried by the CONSTITUTION.

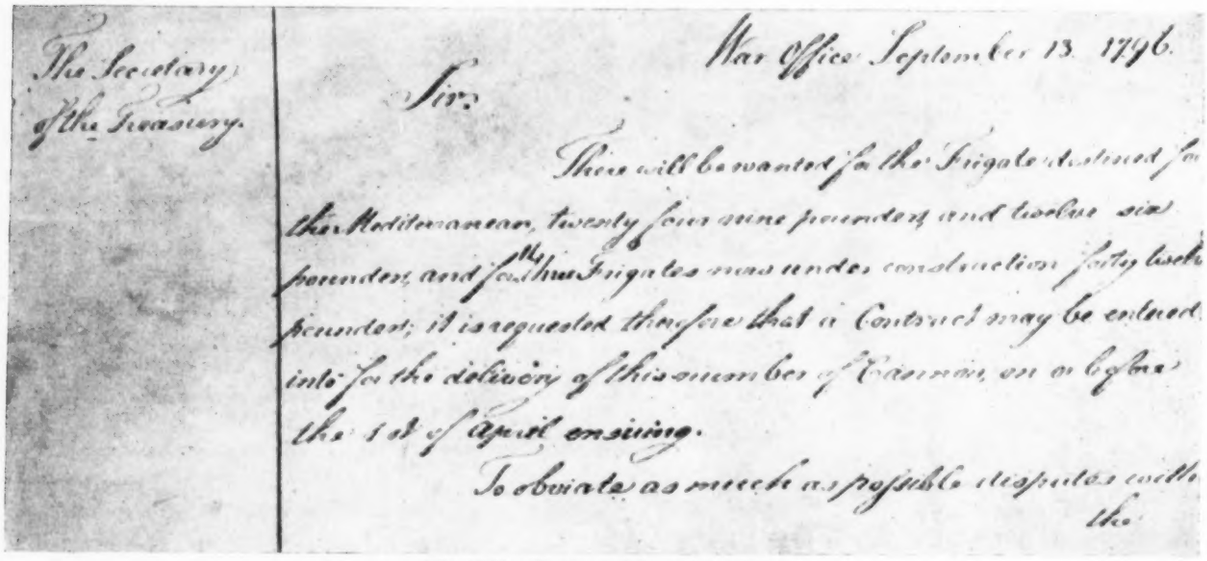
"The estimates upon which the appropriation of $100,000.00 was made for the restoration work of 1906 were asked for by telegraph and were similarly submitted within twenty-four or forty-eight hours from the receipt of the order, because the Naval appropriation bill was then in the final stages of conference and there was no time to be lost. The funds voted were thus based upon a necessarily quick snap judgment guess only, and as it proved were not sufficient to permit of too great nicety in their expenditure for detailed differences in the battery. Upon closing the accounts at the end of the fiscal year, the expenditures amounted to somewhere in the neighborhood of $99,996.00.

"Apart from the *insurmountable obstacle of funds,* I was unable to locate a single one of the CONSTITUTION'S old guns. In fact, this one point was by far the most difficult to solve even with a modicum of satisfaction. The statement therefore that 'when the CONSTITUTION was reconditioned in 1906, the Government found one of her old 24-pounders and *for convenience* (italics supplied) they cast 54 guns from that pattern' needs correction. The reasons real were 'lack of funds' and 'lack of information.'

"A short account of the efforts made to locate information as to this battery is worthy of record here. The Material Bureaus of the Navy Department were unable to throw any light on the whereabouts of the battery or whence correct and accurate information could be obtained. The files of the Public Library of Boston were consulted and there a book was found published in French during the Reign of Terror. This gave considerable information as to the artillery designs near the end of the 18th century, and it was consulted because it was conceived that we borrowed our ideas of guns from England and France. This book had been acquired by that library some thirty-five years earlier and its *first issue* for public use was in connection with the restoration of the CONSTITUTION.

"Then 'The Naval War of 1812,' by Theodore Roosevelt, was consulted, and on pages XVII to XIX of the introduction sketches of a long gun and a carronade were found, also cross-sections showing in a general way their mounting, but none of these gave any dimensions or details. At the bottom of page XIX, a reference was found to the 'American Artillerists Companion,' by Louis de Toussard, Philadelphia, 1811. A copy of this was located finally, as I now believe, in the Library of Congress. This coupled with Roosevelt's work, and the French publication, were the main sources from which the data were drawn. Knowing the weight of the ball fired, and allowing for windage, etc., the draughtsman assigned to the work, Mr. Charles H. Simmonds, was finally able to establish an approximate scale from which to produce the plans used for the guns and their carriages.

"The present guns of the CONSTITUTION are not as heavy as might be thought upon casual surface inspection. As a safety precaution against the use of these guns for saluting purposes by enthusiastic but uninformed laymen should the battery ever be lost in the long years to come, a diaphragm was cast across the bore



War Office September 13 1796.

The Secretary
of the Treasury.

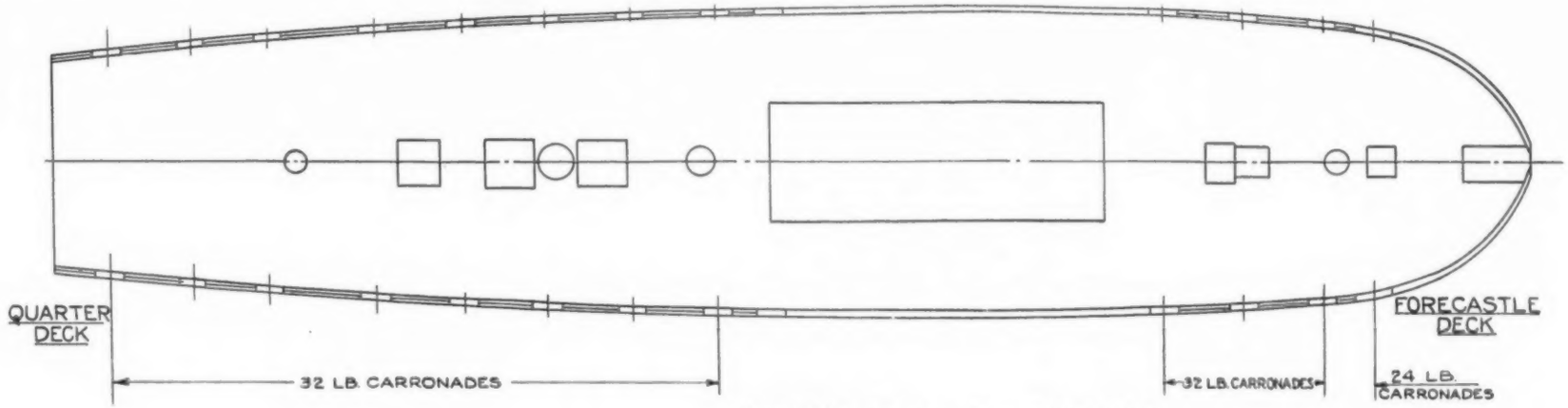
Sir.

There will be wanted for the Frigate destined for
the Mediterranean, twenty four nine pounders and twelve six
pounders, and for the Frigates now under construction forty two
pounders; it is requested therefore that a Contract may be entered
into for the delivery of this number of Cannon, on or before
the 1st of April ensuing.

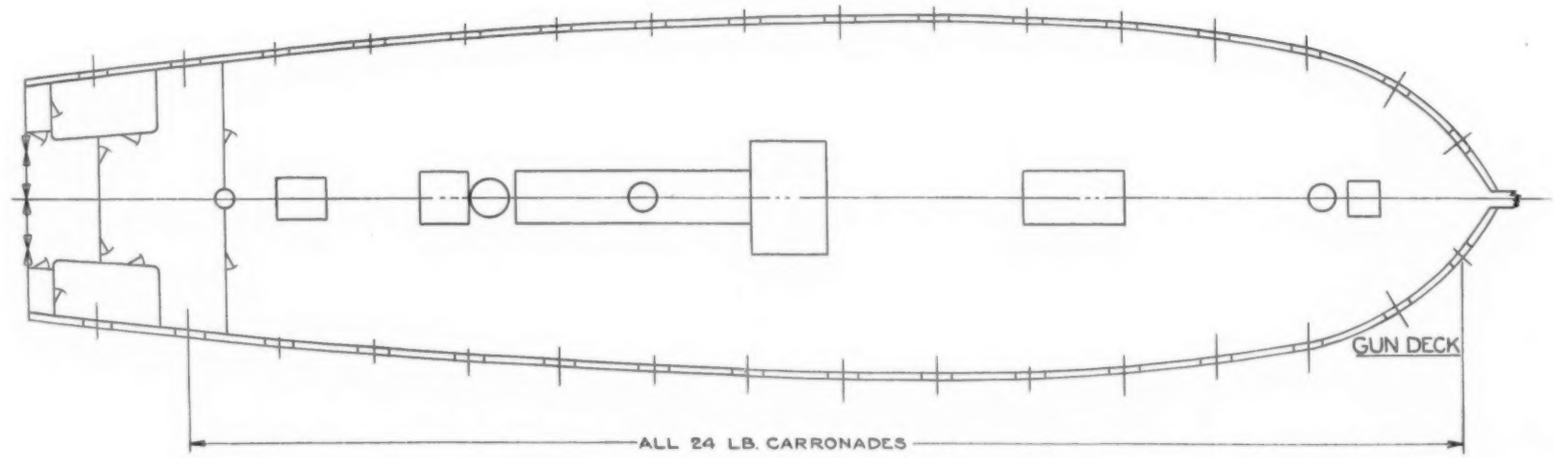
To obviate as much as possible disputes with
the

War Office Letter of Sept. 13, 1796.

The affairs of the Navy were administered by the Secretary of War from August 7, 1789, to April 30, 1798, during which period the CONSTITUTION was building. Although this record refers to 9-pdrs., 6-pdrs., and 12-pdrs., some of the tests and inspections prescribed for smaller guns were probably applied to the guns of "Old Ironsides."



GUN DECK - - - - - - - - - - - 30 - 24 LB.
QUARTER DECK - - - - - - - - 16 - 32 LB.
FORECASTLE DECK - - - - - - - 6 - 32 LB
FORECASTLE DECK - - - - - - - 2 - 24 LB
TOTAL — 54



OLD
U.S. FRIGATE CONSTITUTION
BATTERY PLAN

U. S. S. Constitution—Battery Plan.

The battery carried by this historic vessel has been made the subject of much research. The consensus of opinion accepts the battery as given on this plan as being that carried by "Old Ironsides" in 1812.

about one foot back from the muzzle. From that point on to save weight and expense, the remaining part of the guns have a very thin wall. As a further precaution the vent from the powder pan (where the priming powder was touched by the glowing slow match), was left undrilled into the inner thin-walled powder chamber. These devices had to be adopted to keep the expenditures within the appropriation and yet in the end have a fairly finished ship upon which lovers of the sea and its Navy might look with pardonable pride."

The Navy from 1775 to 1798 was controlled in turn by no less than five agencies: "A Marine Committee of Congress, 1775"; "A Board of Admiralty, 1779"; "A Secretary of Marine, 1781"; "An Agent of Marine, 1781"; on August 7, 1789, the administration and control of the Navy was placed in the hands of the Secretary of War. It was not until nine years later, April 30, 1798, that the act was passed under which the Navy Department was created and placed under a "Secretary of the Navy."

One reasonable explanation for the lack of original documents, wherewith to settle the many interesting questions that arise, concerning details and tests of the battery of "Old Ironsides," is to be found in the loss by fire in 1800 of the original records of the Navy then in the custody of the War Department.

The Navy Department has, however, in its historical records, copies of some of "the correspondence with reference to Naval matters during the time the affairs of the Navy were in the hands of the Army." This fact developed subsequent to the correspondence already quoted, and it was hoped that it might contain some sketches or data that would throw more light on the details of design and possibly proving tests of the CONSTITUTION's battery. None has thus far been found. The memorandum shown on page 156, says, under date of September 13, 1796, the year before the CONSTITUTION was launched, "there will be wanted for the Frigate destined for the Mediterranean twenty-four nine pounders and twelve six pounders and *for the three frigates now under construction forty twelve pounders.*" The natural query is—"Did this reference to the three frigates 'now under construction' include the 44-gun frigate CONSTITUTION"?

Apart from the speculation one may indulge in, as regards the destination of these "cannon," the whole document contains other ordnance matters of interest and so is here quoted in full—the signatures to this instrument were not found.

"War Office, September 13, 1796.

The Secretary of the Treasury.

Sir:

There will be wanted for the Frigate destined for the Mediterranean, twenty-four nine-pounders, and twelve six-pounders, and for the three Frigates now under construction forty twelve-pounders; it is requested therefore that a Contract may be entered into for the delivery of this number of Cannon, on or before the 1st of April ensuing.

To obviate as much as possible disputes with the person who may engage to furnish them, it may be proper that the Contract should comprize the following conditions:

1. That the Guns be cast in the solid and bored.

2. That the twenty-four nine-pounders and twelve six-pounders conform exactly in weight, bore, caliber, and length to British Ship Guns of the same dimensions now in use.

3. That the forty twelve-pounders be formed agreeably to the dimensions laid down, in the annexed draught.

4. That the Guns after having been bored and before undergoing any proof, shall be examined by one or two persons to be appointed by the President of the United States, in the presence of such other person as shall be named by the owner of the works. That this examination shall commence by a verification of the diameters of the different parts and ascertainment, whether there are more internal and external cavities or defects than are specified in the annexed Table, exhibiting the defects which are to be tolerated. That in all cases where the bore or caliber is found to be less than the diameter prescribed; and the defects not greater than those tolerated, the Cannon shall be returned to the boring machine, to be enlarged, before being proved; and in all cases where the defects are greater than those tolerated, the examination shall cease, and the Cannon be rejected.

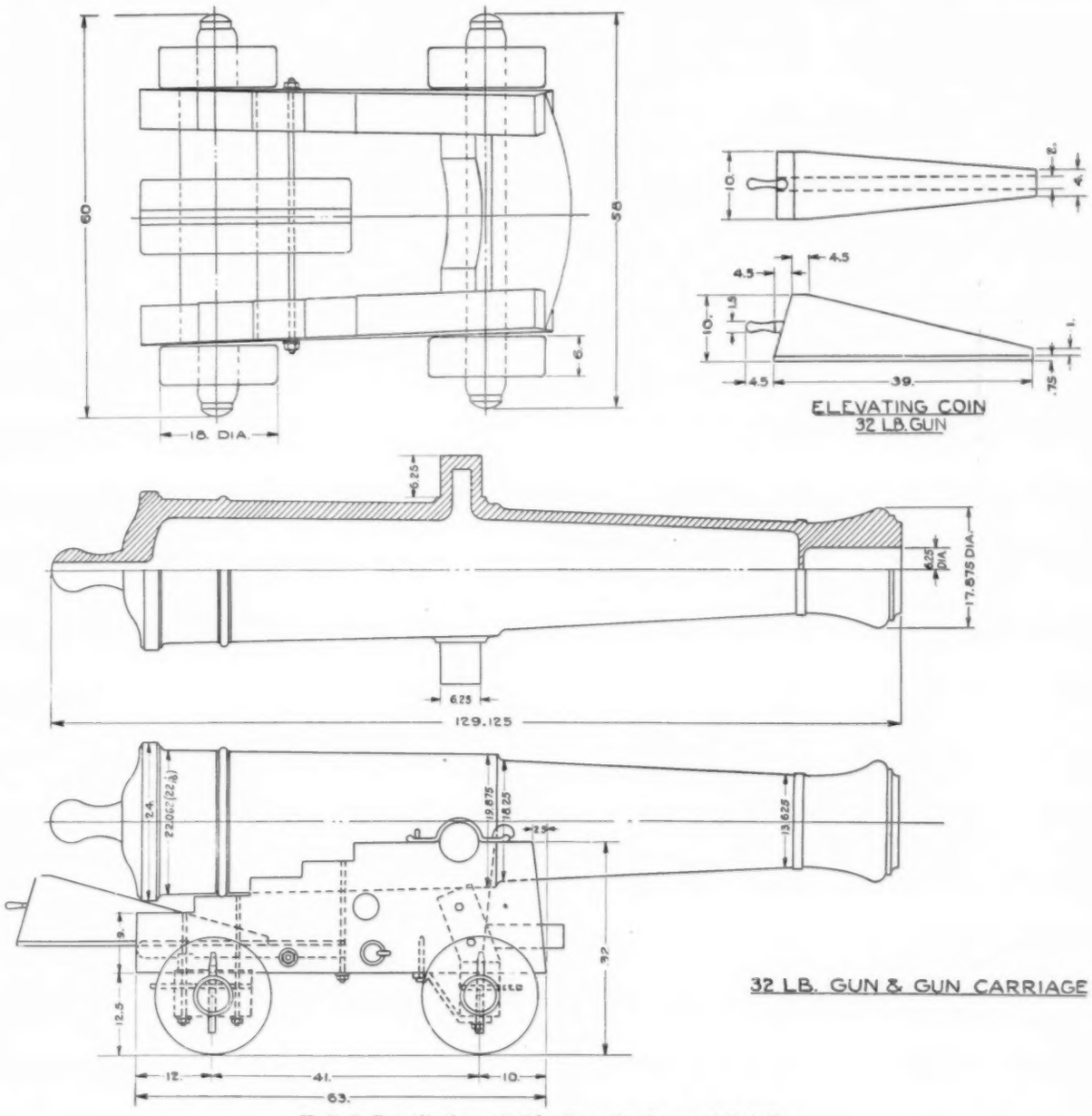
5. That the instruments commonly employed to ascertain dimensions, and discover cavities or holes in the external and internal parts of Guns shall be used on such occasions.

6. That the Touch-hole must end in the cannon, at the middle of the rounding of the Angle at the bottom of the bore. That should any holes be found in the Touch-hole, deeper than the twentieth of an inch, the Cannon cannot be admitted to proof, till the same shall have been filled up with beaten iron.

7. That the Trunnions must be perpendicular to the vertical plane, which is supposed to pass through the Touch-hole and to cut the bore into two equal parts. That the upper part of the Trunnion shall be level with the center of the caliber, or bore, and that the usual relative weight be preserved between the Breech, and Chace.

8. That the proof by powder shall be as follows, viz.: Each Cannon shall be proved by two successive discharges. The weight of the powder for the first discharge shall be equal to two-thirds of the weight of the ball and for the second equal to half the weight of the ball. The Cartridge shall be well rammed down with a wad over it; two balls shall be placed over that with a wad of hay between them, and a wad over, which shall be well rammed down; the balls to be measured so as to allow a sufficient windage, and approved of by the Officers who shall make the experiments, and the owner of the works, or any person whom he may appoint for that purpose.

9. That to ascertain the strength of the Trunnions the Cannon must be placed on two pieces of wood having indentations large enough to receive two-thirds of the Trunnions, and with the hinder part at a sufficient distance from where the Trunnions lodge, so that the breech may be inclined in any direction, but never so as to rest



U. S. S. Constitution—32-Pdr. Gun, Carriage and Details.

As to the accuracy of these plans, see the text of the article. The plans show the "coring out" of the bore to lighten the weight of these dummy guns, also the diaphragm across the bore to prevent the guns from being used for saluting purposes.

on the ground. The proof by powder must be made on these pieces of wood.

10. That the Cannon which shall have stood the proof by powder, shall be raised from off the temporary carriage, and placed upon a supporter, so that they may be filled with water. That should the water on being compressed filter through any part of the Cannon, it cannot be received though it has stood proof.

11. That the Cannon which shall have stood the aforesaid examination and proofs, shall be subject nevertheless to be re-examined, and should new holes be detected, or the ones tolerated found to have been enlarged by the firing; all such Cannon must undergo a second proof, but of one discharge only; when if the holes exhibit no further enlargement, they shall be admitted, and receipted for, after being weighed.

12. That the weight of each Cannon received, shall be marked on the left Trunnion.

As Cannon which have not undergone the above examination and proofs, cannot be used by the United States without putting the success of those military undertakings in which they may be engaged, at risk; and as the principles and regulations here laid down, have been the result of much experience, and long adopted for the verification of Cannon by the principal Nations in Europe, they may be considered as guides that ought not to be departed from. It is requested therefore, that the Contract shall be so formed, as to ensure a strict and punctual compliance with each and all of the above mentioned conditions.

P. S.—The draft for the 12 pounders, which is in hand, will be furnished in a few days.

Defects to Be Tolerated in Cannon for the Use of the Marine of the United States.

			Tenths of an Inch
Bore		more than the prescribed diameter	1
		less than idem	½
Interior holes		Depth of the interior holes	2¼
		a succession of little holes, one of which will be	1½
Exterior holes	Upon the Reinforce	In a direction towards the muzzle	2¼
		In a direction parallel with the surface	4
		A succession of little holes, one of which will be	2
	Upon the Volée, or Chace	Directed towards the muzzle	2½
		In a direction parallel with the surface	
		A Continuation of little holes, one of which will be	2
	Upon the hind and under part of the Trunnions		4
	A tenth of an Inch more will be tolerated upon the front and upper part of the Trunnions.		
Holes at the edge of the muzzle	If they are in a direction towards the muzzle, and if they are 8/10 of an inch deep, the Cannon cannot be received. It shall also be refused if the holes are 6/10 of an inch deep, and are directed toward the muzzle.		
Touch-hole	Upon the diameter	more than	½
		less than	¼
	Upon the exterior position of the Orifice		1½
	Upon that of the interior Orifice	In front of the point where it ought to be	2½
		Behind the same	1½
	The holes in the interior part of the Touch-hole—those 1/2 tenth of an inch deep."		

"The frigate destined for the Mediterranean"! What a sense of humiliation follows the train of thought aroused by these words written so long ago! *A 36-gun frigate* CRESCENT *built (by us) for tribute to the Day of Algiers* launched at the Navy Yard, Portsmouth, June 29, 1797. She carried 26 nine-pounders and 12 sixes. The three frigates then building were the CONSTITUTION (44) UNITED STATES (44) CONSTELLATION (36).

Among "the military stores requisite for the Frigates" sent to Samuel Hodgdon by the War Office, June 12, 1797, are listed:

44	blunderbusses,
300	boarding pikes,
120	battle lanthorns,
670	barrels of powder,
10000	round shot for 24-pounders,
1600	chain and double headed shot for 24-pounders,
2200	stools of grape and cannister for 24-pounders,
4600	round shot for 12-pounders,
720	double headed shot for 12-pounders,
900	stools of grape and cannister shot for 12-pounders,
18	howitzers eight inch or of 4 or 6-pounders,
600	hand grenades.

Of the "round shot for 24-pounders" thus ordered, 3600 (120 rounds for each gun) were ordered shipped to Boston for the CONSTELLATION July 1, 1797. The cost of the guns and military stores of the CONSTITUTION was $32,175.

The iron 24-pound cannon intended for the Frigate UNITED STATES, a sister to the CONSTITUTION, were found unfit for service in their present state—March 19, 1798. A request was accordingly sent to John Jay at the instance of the President of the United States for a loan "of thirty of the iron 24-pound cannon which the State of New York had obtained from a foundry in Connecticut." It may be asked "Did any such like experience befall the 30 24-pounders for the CONSTITUTION?" That the Government failed at first to get the 12-*pounders intended for the upper deck* battery is shown by the following letter:

"War Department, 30th May, 1798.

His Excellency,
The Governor of
Massachusetts.

Sir:

It is extremely desireable, that all the Naval forces the United States can command, should be put into a state of activity as speedily as possible.

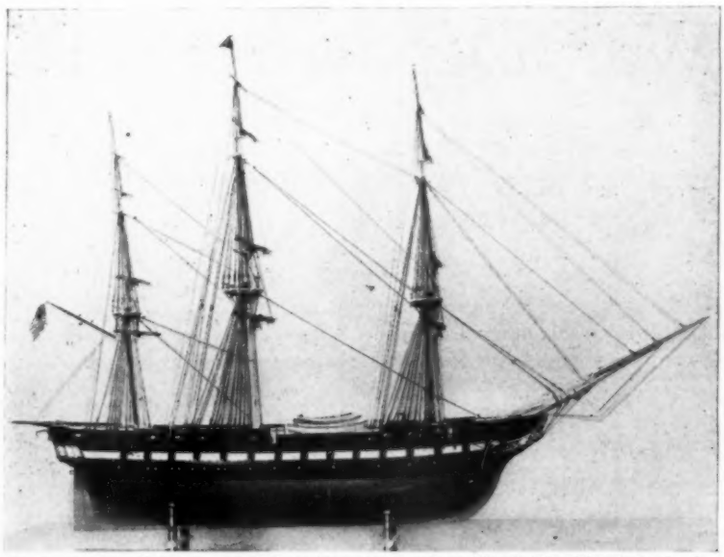
Hitherto and particularly by the failure of a contract the Government has found it impracteable, to procure the cannon requisite for the upper Battery for the Frigate Constitution at Boston. It has however lately been stated that there were at Castle Island, in the Harbour of Boston, nineteen iron cannon of caliber to carry eighteen pound shot, which from their length and weight appear to have been designed for ship's use, and to be improper for the embrazures of Fortifications. That Captain Nicholson has seen and examined these cannon, and is very desirous to obtain them for his ship.

By the direction of the President, I have therefore to request of your Excellency a loan of fourteen or sixteen of the cannon mentioned, and to offer on the part of the United States, an engagement, either to return the same guns as soon as others can be provided for the Frigate, or to replace them with guns equally good, and in the mean time, if desired, to order the same number of thirty-two pound cannon from Providence to, and for the defence of, Boston Harbour.

It is presumed that the State of Massachusetts has had balls purposely cast for these 18 pounders, if so, and your Excellency will furnish with the cannon a suitable quantity of shott, the United States will punctually & promptly return an equal quantity.[1]

[1] "Correspondence on Naval Affairs when Navy was under War Department. 1790. 1798."

It is possible, though it cannot be affirmed with certainty, that many of the "Sea Gunners Instructions," established at the Court of St. James on the 7th day of January, 1730, affecting the handling of ammunition and the care of the battery of His Majesty's Navy, were observed by the Navy of the United States at the time the CONSTITUTION saw her first service. We, men of the sea, borrow much from one another and hold on to "old" customs. From those instructions we learn:



U. S. S. Constitution—Model at The U. S. Navy Yard, Washington, D. C.
The battery is in full view here; note also the stowage of boats, nested amidships and the Captain's "gig" at the stern. The figure head of "Andrew Jackson" is carried by this model.

"IV. That the Powder in Copper hooped barrels be lodged on the Ground Tier and last expended."

"VII. That Parchment Cartridges filled will not last above three weeks" and but *three* rounds be kept filled at a Time, paper being found more durable as well as less expensive."

"X. That he (the Gunner) is not under any Pretence to stave empty Powder Barrels but preserve them in order to shift such as may *be decayed.*"

"XI. That an allowance was made of "five Charges of Powder and five shot, once a Month for the exercise of the Upper Deck Guns."

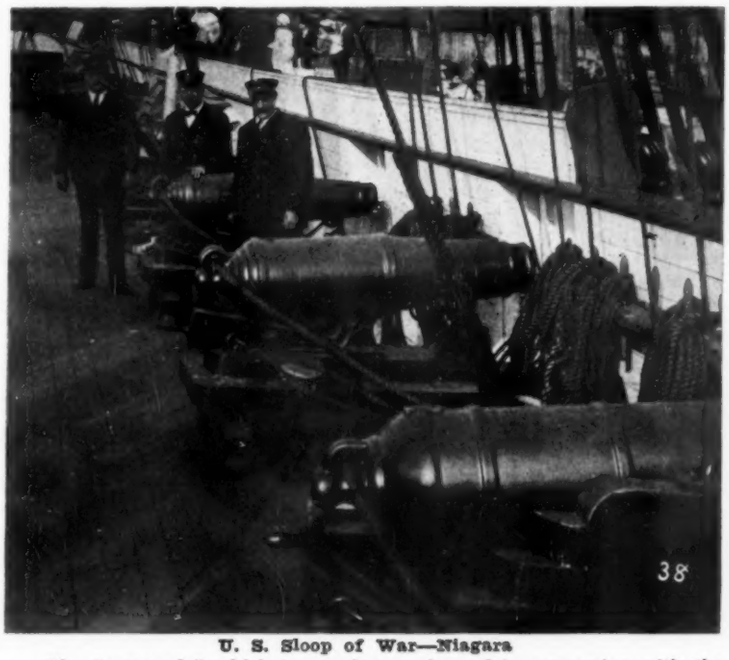
"XV. That "the Guns are not to be sealed oftener than necessary" and "when loaded for service are to be kept well Tampioned and *Fidded at the Vents* with O chain."

"XVI. That guns struck into the Hold for any reason were "to be payed all over with a Coat of warm Tar and Tallow mixed together, and a good full Wad, dipped in the same a Foot within the Muzzle and a tampion well fixed therein, also a Cork of O chain as well put into the Vent to prevent their receiving Damage."

"XX. That "there will be placed on all Cannons for Sea Service Notches or Sights on the Base and second Reinforced or Muzzle Rings, for Horizontal and Vertical Directions, for the better guiding the Aim; and the Notches are to be marked with White Lead."

"XXI. That "It appearing by Experience that double round Shot round and double headed shot or round and Grape shot together is dangerous, and more to the Detriment than good of the Service, he is to take care to prevent that Practice in Time of Action, and to see that Guns are not loaded with such Mixtures; nor to suffer any Iron Crows to put into them * * *."

Of course, "accounts" were prescribed in these instructions and they were required to be made up at *Midsummer* and *Christmas*. Frugality, in the use of "matches" (lighted tow) was enjoined and no more than two were kept lighted at night to prevent a surprise attack. The matches thus kept burning were always kept hanging over tubs of water.



U. S. Sloop of War—Niagara
The "carronade" which is so often spoken of in connection with the battery of the CONSTITUTION and other vessels of her day was "a cannon of peculiar construction, much shorter and lighter than the common cannon and having a chamber for the powder like a mortar; they are generally of large calibre and carried on the upper works as the poop and forecastle. It derives its name from Carron in Scotland, where they were first made" (Mariners' Dictionary, 1805). The guns shown in view of the spar deck of the sloop "Niagara," one of Perry's fleet that fought at the Battle of Lake Erie—since raised and restored—gives a good idea of this type of gun.

Little more remains to be said on the subject of the battery of this "redoubtable enemy of Great Britain" that sailed the high seas and covered herself with glory during the war of 1812.[2] A closing word of caution and another of appeal only will therefore be added. One should not be too dogmatic as to detail, during the coming reconstruction of "Old Ironsides," yet adherence to recorded data is necessary. It is hoped that all who have any authentic information about the battery or any other features of the U. S. S. CONSTITUTION will not hesitate to communicate it to the naval authorities.

[2]In the American State Papers on Naval Affairs, part 1, commencing on page 52, much information will be found concerning the guns and batteries of the Constitution and other vessels of her day.

The War Department Budget

By

Maj. Gen. Kenzie W. Walker, Chief of Finance, U. S. A.

Budget Officer for the War Department

A BRIEF discussion of the Budget seems appropriate at this time when its effect upon the national defense is being so generally featured in the press and is so much in the minds of military men.

The Principle

It will no doubt be accepted by all that the principle of the budget is sound, that it is just as important for the Government to balance its budget—to make its outgo come within its income—as it is for individuals and business organizations to do so. The remarkable thing is that, in a great nation whose people as a whole are more or less familiar with the business methods and management of corporations, we have been so slow to adopt the principle of a national budget for the handling of our government finances. While officers of private corporations are not ordinarily limited by law in such manner as to make it necessary for them to operate under formal appropriations it is with them the ordinary, accepted method of transacting business to have the president of a corporation, as the responsible head of the executive branch, lay before its board at its annual meeting a report setting forth what has been done during the past year and what is proposed for the coming year, accompanied by statements of receipts and expenditures, with estimates and recommendations as to how proposed expenditures shall be financed. With this common experience and the fact that for years other great nations were successfully operating under a budget, it is indeed surprising that the adoption of the budget principle was so long deferred.

Effect of Tax Reduction on National Defense

It is obvious that tax reduction is desirable and that the public debt must be paid although the rate at which this debt should be paid may be open to argument. This rate of payment presents many perplexing questions the answers to which may have great influence upon the future well-being of the country. It may well be questioned whether it is wise to shoulder this entire burden upon the present generation or whether the next generation should bear its share of it. It is held by some that the longer term payments extended to some of our Allies in the settlement of their indebtedness to our government, while we proceed to liquidate our own public debt within a relatively shorter period, places an undue burden of taxation on the present generation. However, these are political questions that military men are not called upon to answer and whatever the answer may be it is our duty to conform. But we are greatly interested in the answers because of their influence on military appropriations made for the national defense. Military men are certainly as patriotic and honest as the average educated citizen and are certainly better qualified to know the needs of the country for its reasonable defense. They realize more than any other group the enormous cost in blood and treasure of unpreparedness. They are therefore greatly interested in political decisions which may directly or indirectly affect the national defense even though they play no part in the making of such decisions.

Present Policy

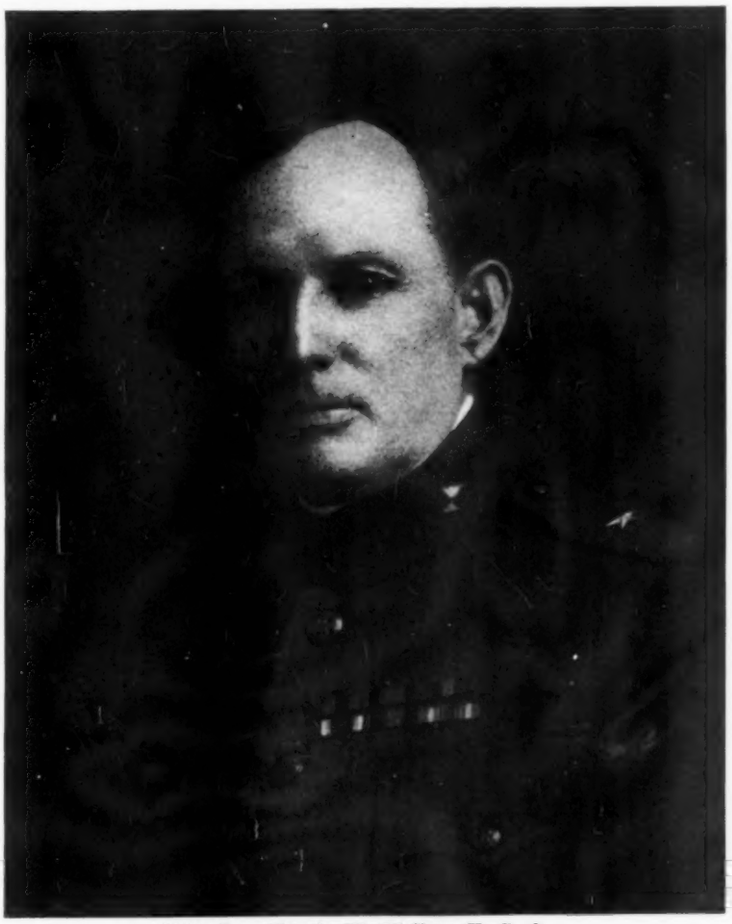
The policy of the President as well as of the Congress seems to be to reduce taxes now and as rapidly as possible, at the same time making substantial annual reductions in the public debt. As reduced taxes mean reduced income it follows that there must be reduced appropriations if the budget is to be balanced, and it is reasonable to expect that the military departments would have to share in these reduced appropriations. This expectation has been realized. But these reduced appropriations for the military establishment of the War Department have in the main been met by drastic economies in administration and certainly the military establishment should be willing to go the limit in this direction. Its future welfare depends upon it.

These economies have however prevented the department from developing and training the citizen components of the Army as rapidly as it thought desirable, and have jeopardized the maintenance of a reserve of vital items that can not be placed in production with sufficient rapidity to meet the needs of a general mobilization of man power, and material further reductions will almost certainly be reflected in reduction in strengths as well as in efficiency for they can not be entirely absorbed by further economies in operations although some further economies may be found and applied. This conclusion cannot be escaped when it is recalled that the Army has been living to a great extent upon its surplus war stocks which are rapidly disappearing and current needs must be met from current appropriations.

The President's Functions

The Budget and Accounting Act gives in Section 201 thereof the duties and functions of the President in reference to the fiscal matters of the government. This act is the first effort in the history of the country to give the President an active part in the building of estimates, his contact with them in the past being limited to his approval or veto of appropriation acts. The act in fact makes him the head of the business organization of the government and gives him the responsibility of submitting to Congress a budget estimate that will come within the estimated income, or if he cannot do this requires him to submit to Congress with the budget his recommendations for the necessary legislation to bring in the required additional

income. The act authorizes him to increase or decrease the department's estimates for their various projects and to add to or take from the estimates entire projects. It gives him as his operating activity in this respect the Bureau of the Budget with a Director and an Assistant Director. It makes the budget estimate that finally goes to Congress his estimate and not that of the Departments. His is the entire responsibility. The significance of that little clause in Section 2 of Article II of the Constitution, "The President shall be Commander-in-chief of the Army and Navy of the United States," was never more fully realized by the Army than in the application of the Budget and Accounting Act. Regardless of what plans or programs may be adopted by the various Departments, they are all subject to the President's economic policies, and can be made effective only to the extent that he approves estimates for their accomplishment.



Maj. Gen. Kenzie W. Walker, U. S. A.,
Chief of Finance
Budget Officer for the War Department.

The Department's Budget Officer

The authority for the designation of the Budget Officer for the War Department is contained in Section 214 of the act and the duties of the head of each Department (the Secretary of War) are contained in Section 215.

These sections read as follows:

"Sec. 214. (a) The head of each department and establishment shall designate an official thereof as budget officer therefor, who, in each year under his direction and on or before a date fixed by him, shall prepare the departmental estimates.

"(b) Such budget officer shall also prepare, under the direction of the head of the department or establishment, such supplemental and deficiency estimates as may be required for its work.

"Sec. 215. The head of each department and establishment shall revise the departmental estimates and submit them to the Bureau on or before September 15 of each year. In case of his failure so to do, the President shall cause to be prepared such estimates and data as are necessary to enable him to include in the Budget estimates and statements in respect to the work of such department or establishment."

The Chief of Finance was designated by the Secretary of War as Budget Officer for the War Department by orders dated June 11, 1921, and on June 27, 1921, he addressed a memorandum to the Budget Officer for the War Department on the subject—"Preparation of War Department Estimates," which, after quoting Section 214 of the Budget Act and stating that the Chief of Staff would furnish the Budget Officer for the War Department with the military program, stated:

"The Budget Officer for the War Department is authorized to secure direct from the War Department General Staff, and from the various bureaus and services of the War Department, such information, advice and assistance as he may deem necessary in the preparation of the estimates.

"The above instructions, in so far as they are applicable and except as may be later modified, will apply to the preparation of all future estimates, annual, supplemental or deficiency, this procedure having received the concurrence and approval of the Director of the Budget."

How the War Department Estimate Is Built

With the above background as to the authority and duties of the Budget Officer for the War Department a brief outline of the manner of building the estimate may be useful.

(a) *Military Program.* The basic directive in building the estimate for the military establishment is the enunciation by the department of a definite program which it desires for the particular fiscal year together with certain principles controlling them. The statement of this program is a purely Staff function and in the enunciation of it the Budget Officer has no direct interest except that he is much concerned that the program announced is one which can be carried out within the policy announced by the President. A program beyond the probable "limiting figure" that will be allowed by the President under his economic policy results only in a vast amount of work for all the services and for the office of the Budget Officer for the War Department in the subsequent revision of the preliminary estimates to meet the maximum allowed.

The initial steps toward building this program are taken by G-4, which division of the General Staff consults and collaborates with the other Divisions of the General Staff in its making. After it has been approved it is sent to the services and to the Budget Officer for the War Department and is his basis for the building of the preliminary estimate.

(b) *Preliminary Estimate.* The first step in building the Budget estimate for any fiscal year is a call from the Director of the Bureau of the Budget for a preliminary estimate of the War Department's requirements. In this call the Director makes no reference whatsoever to the President's policy as announced at the Business Meeting or otherwise and places no limitations on the Department.

On receipt of this call the Budget Officer for the War Department calls on all the estimating services to submit an estimate of their needs in compliance with the War Department's program. The attention of the estimating service is usually called to the President's policy and an effort made to have the services submit an estimate which will carry out the Department's program in such an economical way that it will come within the President's policy. This, of course, is an impossible task, unless due consideration has been given by the Department to the President's policy in building its program. It is interesting to note in this connection that for the fiscal year 1926 the total of the preliminary estimates for the military establishment as submitted by the operating services amounted to $326,244,606 (including departmental), which was $62,526,033 more than the corresponding appropriation for the fiscal year 1925.

(c) *Study by the Budget Officer for the War Department of the Estimates of the Services.* In response to the call for the preliminary estimates the Budget Officer for the War Department finds himself with a total estimate submitted by the services far in excess of the total of the current appropriations and must begin an intensive study to determine what items can be reduced and still carry out the military program, after which the problem as to the changes that must be made in the program presents itself.

(d) *Budget Advisory Committee.* Naturally the Budget Officer would not be in position to reach by himself conclusions which are so important to the military establishment and in order to have available working on this almost impossible task those who are in close touch with the desires of the Chief of Staff, the Budget Officer for the War Department requests the Chief of Staff to designate members of the General Staff to report to him and advise and assist him in this revision of the preliminary estimate. This is in accordance with the instructions of the Secretary of War heretofore referred to. He likewise requests the Assistant Secretary of War to designate a representative from his office to join with the General Staff representatives in this advisory capacity.

For the fiscal year 1927 these advisers of the Budget Officer, who are designated in the Department as the Budget Advisory Committee, consist of a representative of the office of the Assistant Secretary of War, a representative of the War Plans Division, a representative of G-3, a representative of G-4, and a representative of the office of the Budget Officer for the War Department; and to this Advisory Committee is given the task of determining what reduction could be made in the estimates of the various activities so as to enable those activities to operate at a lesser figure than those activities estimated for, through economies and changes of methods if necessary, and by this means to reduce the estimate to the lowest possible figure and at the same time carry out the War Department's program.

After the receipt of the estimates this committee held hearings every day for several weeks, brought before it representatives of the various services and coördinated their needs to bring them within a figure that the Secretary of War considers essential for the proper maintenance and operation of the military establishment.

(e) *Action by the Chief of Staff.* This estimate for the military establishment is forwarded to the Chief of Staff for his review and such recommendations as he may have to make to the Secretary of War in regard to it. The agency used by the Chief of Staff for the study of this preliminary estimate and for the submission to him of recommendations in regard to it is the Legislative Council of the War Department, which is composed of the Deputy Chief of Staff, the chiefs of the five General Staff Divisions, the Adjutant General of the Army, the Judge Advocate General of the Army, and the Budget Officer for the War Department. After review by the Legislative Council the preliminary estimate is submitted to the Secretary of War by the Chief of Staff and the Budget Officer for the War Department, and at the same time the Budget Officer for the War Department submits the estimates in regard to the non-military items of the War Department's bill.

(f) *Action by the Secretary of War.* After consideration and action by the Secretary of War the preliminary estimate is returned to the Budget Officer for the War Department who forwards it to the Director of the Bureau of the Budget where it is given consideration in conjunction with the preliminary estimates of other departments of the government and where, no doubt, the aggregate of all the preliminary estimates for all the departments amounts to many millions in excess of the aggregate of all the appropriations for the preceding year rather than less as the policy of the President requires.

The Director of the Bureau of the Budget from his consideration of the estimated income and of what has been represented to him by the various departments of the government, together with such information as he may have collected through the means of his investigating agencies, reaches a decision and as the result of it gives the tentative maximum figure under which an estimate must be submitted by each department for his consideration.

(g) *Tentative Maximum Figure.* At the time the tentative maximum, which is usually referred to in the War Department as the "Limiting Figure" is given to the War Department the Director of the Bureau of the Budget advises that if the War Department finds itself unable to carry on all its essential functions within the limiting figure, it may submit a list of supplemental requirements giving in each case a detailed statement of the necessity for the amount involved, and this statement is usually referred to as the "Supplemental Estimate."

The first step is to determine if there can be further reductions made in the estimates of the various services which will still allow the carrying out of the War Department's program, and the next step is to determine what changes must be made in the program to come within the

limiting figure and what items are so essential that they must be included in the supplemental estimate. In this revision of the estimate for these purposes the Budget Officer for the War Department refers the problem to the Budget Advisory Committee for restudy and recommendation.

After many days of intensive hearings and study this committee submits its report and recommendations to the Budget Officer who transmits them with his action to the Chief of Staff for consideration. The Chief of Staff again uses as the agency for considering these recommendations the Legislative Council and with these studies and conclusions, the primary estimate, by appropriations, together with the statement of supplemental requirements, is presented to the Secretary of War by the Chief of Staff and Budget Officer for the War Department in person. The Secretary of War gives much consideration to all the details involved and his decision forms the basis of the primary and supplemental estimates which the Budget Officer for the War Department ultimately transmits to the Bureau of the Budget.

(h) *Call for Estimates Under Tentative Maximum.* The Budget Officer for the War Department upon receipt of the decision of the Secretary of War as to the amount to be carried under each appropriation in the primary estimate and in the supplemental advises the services of the amounts so approved, and each service then submits the so-called "green sheets" for each appropriation and prepares its detailed defense of the amounts carried both in the primary estimate and in the supplemental, the primary and the supplemental together constituting the War Department's estimate of its needs. These estimates are then compiled and transmitted to the Bureau of the Budget by the Budget Officer for the War Department with the statement of supplemental requirements.

Consideration by the Budget Bureau

Upon receipt of the estimate and statement of supplemental requirements the Director of the Bureau of the Budget holds extensive hearings in which he calls before him witnesses of all the interested services and as a result of these hearings and of the consideration of the information compiled in his office he ultimately recommends a Budget estimate which when finally approved by the President is carried in "The Budget" as presented to the Congress. The Budget Officer acts as liaison between the War Department and the sub-committees of the House and the Senate Appropriation Committees during the hearings before the sub-committees and arranges for the order of presentation of the evidence and the appearance of the witnesses.

Effect of the Budget and Accounting Act Upon the War Department

It can be asserted with considerable positiveness that the new coördinated method of making estimates within the department and of considering these estimates within the Congress is in the interest of the War Department. Frequently the statement has been made that the Budget system resulted in reduced appropriations for the War Department, but a review of the policy which has been followed by this government after each of our wars would indicate that decreasing appropriations should have been expected following the World War.

As a matter of fact, it is believed that the Budget system has benefited the War Department. It is thought that no greater appropriations in the aggregate would have been obtained from Congress if each of the services had been allowed unhindered to present to the Congress their complete requirements as they viewed them. Some services which at the time had popular approval undoubtedly would have received greater appropriations, but others equally as important would have received lesser ones.

The Budget system has resulted not only in the War Department receiving as much in the aggregate as it would have received under the old system, but has enabled the War Department, to a great extent at least, to distribute the amount received as it felt would best meet the Department's needs. Another effect of the Budget system has been to force the operating services to initiate economies and by this means to obtain results at a reduced cost without loss of efficiency. The application of the Act has brought home to all departments of the government the necessity of the elimination from their estimates of all nonessential items, and has made it incumbent upon all the services themselves to take the initiative in such eliminations before presentation of their estimates for the reason that as nonessentials are disclosed from time to time by the Bureau of the Budget they are stricken out and the money they represent is lost to the War Department. It is, therefore, obvious that so long as we must keep our estimates within a so-called "Limiting Figure," if essential items that could be adequately defended are omitted to enable nonessentials to be included, it is highly probable that appropriations will continue to dwindle until the practice is discontinued. The effect of extravagance or wasteful expenditures that come to the attention of the Bureau of the Budget is quite certain to be reflected in its action on subsequent estimates for the appropriations from which such expenditures were made.

But whatever effect the adoption of the Budget system may have had on the welfare of the Army and the maintenance of an efficient national defense its benefit to the people as a whole would seem beyond question. This method of transacting the government's fiscal affairs may now be taken to have been fully endorsed and accepted by the country, and the Budget is with us to stay. The President, who is also Commander-in-Chief of the Army, is responsible to the people for his Budget and the estimates for the War Department contained therein are his. Whatever its effect on our appropriations we too must accept it, and, speaking as one of the Army, our endeavor must be to build our estimates on lines so sound that every dollar asked for can be adequately defended and once obtained is wisely and economically expended.

Economic Factors in the Manufacture of Confederate Ordnance

Part I.

By

Kathleen Bruce, Ph. D.

TO ALL interested in the influence of economic conditions on war and in industrial mobilization the economic history of Virginia in the nineteenth century prior to 1865 offers a field for illuminating study. After careful research,* I feel emboldened to assert that the much criticized act of the Confederate leaders in transferring their seat of government in May, 1861, from the lower border to the northern frontier of the Confederacy within three days of the Union center of supply, was due to the rise of the Richmond coal and iron industries, and in particular the Tredegar Iron Works; and that the peculiar tenacity with which the Confederates held on to Richmond until within a few days of Appomattox may be attributed to Joseph R. Anderson's successful mobilization of the Tredegar mills and machine shops which served throughout the war not only as the chief source of Confederate munitions, but as the laboratory of the Confederacy. In the present paper I shall sketch briefly the conditions created by the rise of the coal and iron industries at Richmond, and I shall tell as far as possible, in the space allotted me, the story of the mobilization of the Tredegar Iron Works and their contribution to the Confederacy.

For nearly half a century Richmond possessed a regional monopoly in coal comparable in more than one respect with that held by Newcastle, England, before the development of transportation and the richer inland mines. Nearly a thousand negro slaves, superintended by white men, were employed in 1841 in the Richmond coal basin; between 1822 and 1842 almost two million tons of coal left the port of Richmond, and Virginian bituminous coal lighted fires in every town along the North Atlantic seaboard where forges and furnaces flamed. When North and South alike hummed with schemes for building the newfangled steam railroads that created a feverish demand for iron, Richmond coal came to have a strategic value in the rapid new processes for making iron. Richmond lying at the Great Falls of James River possessed also mighty waterpower; and potential iron manufacturers, located there, knew that like the coal merchants they would have a water highway on which to send their goods to market. A canal to link Tidewater with the Great Valley, where since the eighteenth century black slaves had hammered out strong fibrous, porous charcoal iron, was even now in the process of construction. With bituminous coal, iron already famed in American foundries for its great tensile strength, power, markets at their elbows, men saw in Richmond the possible Manchester or Birmingham of America. In a community where for a generation capital had accumulated from the coal trade, from lucrative flour mills, from flourishing tobacco factories—the center of tobacco manufacture in the world—and where sound banking was universal, dreamers began to build foundries, puddling furnaces, and rolling mills.

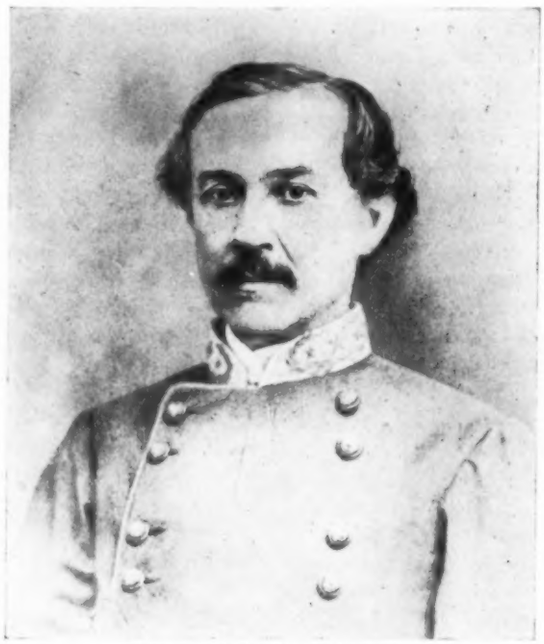
In 1836 but a few years after iron was first puddled and rolled at Pittsburgh, the rolls of the Belle Isle Manufacturing Company were set in motion on a willow fringed island in James River just above the Great Falls. In the following year the Tredegar rolling mill, founded by Deane and Cunningham, started into action, on the mainland, a veritable infant producing in 146 working days, between May first and December, 1837, iron at the rate of seven and one-half tons the day, on which the proprietors (who sold it immediately in the form of the popular bar rail) realized the high profit of $22.22 the ton. The Shockoe Manufacturing Company, later the great machine shops of the South, and the Virginia Foundry Company followed quickly upon the heels of the two rolling mills. D. I. Burr's machine shops, where in 1836 a locomotive was being constructed for the Richmond and Fredericksburg Railroad Company, had been in business at least sixteen years. Deane, the active promoter of the Tredegar, now launched in this dawning age of organization a movement to unite his mill and forge with the foundry of the Virginia Foundry Company. Virginians hastened to take up the stock, and in January, 1838, the Tredegar Iron Company began its fateful career.

Not without the menace of disaster did the infant industry survive. The organizer of the Tredegar corporation saw the vision, but lacked the practical ability to make it real. To avoid extinction the directors of both the Tredegar and the Belle Isle companies were obliged to employ agents to sell their iron and to finance their businesses. The Tredegar agents failed as agents, though they succeeded in becoming successful creditors of the company whose credit became worthless as debt and unsold iron increased. At this juncture destiny placed at the helm a young man to whom the gods had given many of their magic gifts, including a lack of wealth. Joseph Reid Anderson rescued the Tredegar, and in so doing unwitting-

*Author's Note: Every essential fact stated in this paper is carefully documented in my unpublished study of "The Iron Industry of Virginia before 1865 . . ." in the Radcliffe College Library, Cambridge, Massachusetts.

ly shaped the industrial development of Virginia and the policy of the future Confederacy.

Are the controlling factors in history men? Or do the forces which come and go like the wind provide the puppets? If young Anderson had not offered to take charge of the Tredegar works would fate have pushed some other equally eager and capable spirit into the breach? If the Tredegar works had succumbed would the less important iron works at Richmond have been drawn into the vortex? These are questions the answers to which can only be surmised; the fact remains that this young man, a Virginian, one of the five distinguished in a class of forty-nine graduated from the U. S. Military Academy in 1836, not yet of the age which the Greeks deemed requisite to manhood and builder of a road between Staunton and Winchester which may outlive the Commonwealth, succeeded where others under similar external conditions had failed. Time was soon to show that his ancestry, embracing the wide range of pioneer and planter stocks, had endowed him with the qualities of courage and administrative ability, with a constitution strong "in its capacity to endure prolonged application and severe nervous strain" which make up the business man of the first order, and that his West Point training had developed and disciplined these traits and lifted him out of provincialism.



Gen. Joseph R. Anderson

A graduate of West Point in the Class of 1836, General Anderson resigned from the Army in 1837 to serve as Chief Engineer of the Shenandoah Valley Turnpike. In 1841 he became the agent of the Tredegar Iron Company and a few years later bought the works from the Company which then dissolved. Having been appointed Brigadier General, C. S. A., in 1861, in command of the Coast Defenses at Wilmington, N. C., he fought in the battles of Mechanicsville, Gaines' Mill, and Frazier's Farm in 1862. He resigned his commission in 1862 and was detailed by special request of the Confederate authorities to operate the Tredegar Iron Works for the period of the War. General Anderson was president of the Tredegar Company from its incorporation in 1866 until his death in 1892.

Anderson saved the Tredegar by boldly entering the northern markets and successfully competing there with English and American ironmasters. From March, 1841, to November, 1843, he acted as agent of the Tredegar Iron Company; from 1843 to 1848 he leased the works; after January, 1848, he was their owner. Thus he quickly achieved success. In 1844 his total annual profit amounted to nearly $48,000; in 1846 it was more than $98,000; while lessee he became one of four distinguished founders who supplied the Federal government with chain cable, shot, shell, and heavy guns; by 1860 he had built the *Polk*, an ironclad revenue cutter, manufactured the boilers and machinery of the twin frigates, *Roanoke* and *Colorado*, and furnished the United States War and Navy Departments with twelve hundred cannon. In Boston, New York, Philadelphia, Baltimore, and Washington, he made Tredegar iron synonymous with high rank, so that the economist, Zerah Colburn, when stating some time before 1855 the superiority of American charcoal iron to English iron, cited as one would cite any established fact the Juniata, the Sharon, and the Tredegar as the leading American charcoal irons.

A curious and important circumstance to note in the Richmond iron industry after 1850 is the complete reversal in the Tredegar markets and in the markets of the smaller concerns, which, like the settlements of the Middle Ages, that clustered round the strong castle, had sprung up in the Tredegar's wake. Industrially the United States experienced a serious depression in 1849-1850; politically the Wilmot Proviso, attempting to forbid slavery extension in territory acquired by the Mexican War, upset the South; socially planters and southern industrialists, owners and hirers of industrial slave labor, common members of a great slavery fabric, tended to become for the first time mutually sympathetic. Between 1849 and 1854 the Pennsylvania anthracite industry grew at the rate of twenty-two per cent the year, and simultaneously there came a change over the entire South. Southern railroads started rapidly to develop; Southern planters adopted mechanical machinery; Southern politicians coaxed, wheedled, cheered Southern industry. Standing at the gateway of the South, willing to take Southern railway stock or state bonds in part payment for locomotives and other railroad necessities, the Tredegar did not lack for orders. Socially and economically the net spread and thickened; the market of the Richmond iron works lay almost wholly in the South; industrialist and planter alike began to feel that they belonged to a section that was a political entity.

After 1852 the wharves at Richmond were often crowded with the parts of railway locomotives, steam engines, sugar mills, and sawmills, iron for trucks and freight cars, for bridges, and other railroad needs. By December, 1855, at least forty-one locomotives built in the Tredegar shops were running over Southern tracks. In three other machine shops at Richmond men were also constructing locomotives. Iron and machinery vied with the historic exports of flour, coal, and tobacco. The cost of labor rose and the price of iron fell between 1849 and 1853, but the reported value of Richmond's total trade doubled.

Although, according to the United States Census reports, the Virginian yield of pig iron decreased nearly fifty per cent between 1850 and 1860, the manufacture of bar, sheet, and railroad iron grew 194 per cent. The census figures are for the Commonwealth before she lost her western shoulder; they include, therefore, the Wheeling district which in 1860 had two rolling mills. The stride made in iron manufacture, however, west of the Allegheny Moun-

tains must not blind us to the growth taking place in Virginia proper, in the great slave-holding area which historical myth has proclaimed non-industrial. In Petersburg, in Portsmouth, in Alexandria between 1852 and 1860 railway cars or locomotives, steam engines and other machinery were being manufactured. Farther south the industry was spreading; in Georgia two powerful rolling mills were completed in 1856 and 1858, respectively; there were eight rolling mills in other Southern states. But the center of iron manufacture in the South lay at Richmond. Here in 1860, including the various departments of the Tredegar Iron Works there were four rolling mills, fourteen foundries and machine shops, a nail factory, six shops for manufacturing iron railing, two circular saw works, and fifty iron and metal works. The census of 1850, more apt to underestimate than exaggerate, reported 2756 males employed in all the iron furnaces, forges, foundries, rolling mills, and other iron works in Virginia and in the alien section soon to become the State of West Virginia. On irreproachable authority, on the other hand, we are told that more than sixteen hundred mechanics were employed in the iron concerns at Richmond in 1860, and nearly four million dollars invested there in the iron business.

The secession of Virginia could not fail to change the strategy of Confederate leaders on whom devolved the ordeal of equipping an army and constructing a navy. As often declared it was vital to them to preserve the integrity of the great border Commonwealth; but their ground was something more tangible than the desire to keep her moral support. The South was not, as is commonly asserted, a purely agricultural society fighting industrialism. In 1860 it was on the verge of industrial revolution which war precipitated and reconstruction afterward retarded. But no Southern community, apart from Richmond, had a similar manufacturing record stretching back to 1800. Besides the Tredegar and the lesser iron works, the only highly developed coal mines in the Confederacy lay at Richmond. There also the Virginia State armory, recently made modern by the Tredegar Works, and reinforced by the excellent equipment removed from Harper's Ferry, possessed in May, 1861, the sole machinery for making muskets in the Confederacy. The Navy Yard at Norfolk taken in April in the name of the Commonwealth of Virginia brought, in spite of a tradition to the contrary, an immense supply of munitions of war and a foundry and a boiler shop of vast importance. In the Great Valley and on the edge of trans-Allegheny lay lead mined since the American Revolution, blast furnaces in action, and others which could be re-fired; the iron works in Petersburg and Lynchburg could be counted on to aid the government; thus Virginia was industrially requisite to the Confederacy. But how were the people of the Cotton South instantly to be informed of it so that they would send their sons to defend it? The dramatic removal of the capital stood as a symbol: the reason for the transfer the people might not understand, but the significance of it the dullest could not fail to grasp. All knew that they must tenaciously hold the Confederate capital.

By 1860 the Tredegar Works of no mushroom growth had so expanded and strengthened that when a visitor in September, 1860, strolled over the plant, he beheld two rolling mills busily supplying Southern railroads with all manner of rolled supplies; in separate foundries he saw men casting cannon, car wheels, and water-piping for the city of Richmond; he passed through a blacksmith's shop equipped with steam hammer and twenty-five fires, where muscular negroes were forging the fittings of cars and trucks for Southern roads; in the locomotive shops he looked at shining locomotives nearing completion for Southern tracks; there also he watched the construction of marine, stationary, portable, and hoisting engines, sawmills and sugar mills to be scattered through the prosperous South, and in the midst of all he noticed an engine and sawmill being boxed for the island of Cuba now just beginning to offer an extensive market to the Richmond works. The length of these buildings through which the visitor walked ranged from one hundred and forty to one hundred and eighty feet; one was three stories high, another four stories, and the noise in them, particularly in the boiler shops, where the great boilers of the United States frigates *Roanoke* and *Colorado* had been built, almost stunned his ears. Outside he saw a cast steel foundry being erected, and everywhere—in the machine shops, the forge, the spike factory, the foundries—he observed the most improved machinery. He noted especially a Nasmyth hammer for welding heavy shafting, a powerful hydraulic press for forcing a car wheel on the axle with an indicator to show the exact power to effect it, a horizontal self-adjusting boring mill for boring out the eye of a wheel. The expanding works were falling into a new and longer stride. In spite of the fall in price of finished iron products and the rise in labor costs, they were executing work to the extent of over one million dollars a year, no small sum before the advent of "big business." These activities were suddenly halted in November upon the triumph at the polls of the Republican candidate for President.

There succeeded a period of revolution in the lower South: Southern railroads either cancelled or suspended their contracts and stopped payments on materials recently supplied them. Northern exchange could no longer be had, between November and December fifteenth $60,000 was returned upon Anderson and the partners whom he had admitted to the business in 1859; on Christmas Eve they were short by $150,000 to $200,000 on their receipts. Rumor declared that the Tredegar had failed.

It took all of Anderson's acumen to tide the business through a financial storm greater than any he had ever weathered. North and South, the foundations seemed to rock, and Virginia politically, economically, socially was torn by faction. The ironmaster, whose business in its composition and ideals had come to show itself as Southern as a Virginian plantation, sent out a circular letter to the governors of ten Southern States, offering them his foundry and twenty years' experience, five days before the president of the South Carolina Convention declared South Carolina an independent country. On the eve of 1861 Anderson, a Secessionist, swift to think and swift to act, began mobilization.

Not South Carolina, but Georgia first replied. In the midst of the Christmas holidays General Paul J. Semmes, agent, under the written authority of the Governor of Georgia contracted with J. R. Anderson and Company for six eighteen-pounder cannon modelled after the class of gun employed in the United States Army. The cannon were to be subjected to proof prescribed by the United

States Ordnance Manual and delivered within sixty days on board a vessel at Richmond.

The South Carolinians who doubtless had the sixty-four guns which Anderson cast for their State in 1851, left the circular unnoticed until the middle of January. On January seventeenth Anderson, answering a dispatch from Colonel C. G. Memminger, the Secretary of the Treasury of South Carolina, sent the following telegram:

> Have on hand 250 eight-inch shot, 450 eight-inch shell. Can make per day 100 ten-inch shell, 100 thirty-two pounder shot, 25 eight-inch shot. In ten days can double capacity. Will make anything you want. Work night and day if necessary and ship by rail. Prices same as to United States government. Can buy here and ship immediately 1,000 kegs cannon powder at $3.50 per keg.

Within a week Anderson shipped to Charleston by official authority $2,500 worth of shot and shell, and some $2,000 worth of powder. Under the same order ordnance to the amount of $7,000 was still to be sent to South Carolina.

The great rolls in the mills, benumbed by the paralysis of Southern railroads, lay curiously idle in the midst of surrounding activity. But a Marcellus, watching the Tredegar foundries and auxiliary shops running day and night might well have asked:

> ". . . Why such daily cast of brazen cannon,
> And foreign mart for implements of war;
> Why such impress of shipwrights whose sore task
> Does not divide the Sunday from the week;
> What might be toward, that this sweaty haste,
> Doth make the night joint labourer with the day:
> Who is't that can inform me?"

States left the Union; North Carolina, Mississippi, Georgia, Virginia, and Alabama sent in orders; only the Federal Government remained officially blind to the Southern political upheaval.

The agent who called at the Tredegar in February to make a contract for the Confederate Government found Anderson gone to Montgomery. The emissary therefore turned to his next task, while no doubt the ironmaster upon arriving in the crowded Southern town interviewed the President, and possibly the two West Pointers talked earnestly concerning the manner in which the Tredegar

Tredegar Iron Works, 1857 (Canal Side)

The long building (left) is the Virginia State Armory used for the manufacture of small arms, sabers, bayonets, etc. Here, prior to 1861, was stationed a company of enlisted state troops.

might best aid the Confederacy. They could not act until the Convention sitting at Richmond determined the fate of the Commonwealth, for the Tredegar Works might remain in Union territory. Probably, however, the Virginian now made his first offer to turn over the plant to the Confederacy should his State secede, and was refused as he was later upon every subsequent offer. On March 8, 1861, Anderson signed the earliest of many contracts which he made with the Confederate Government: it called for thirty ten-inch columbiads and thirty iron carriages at the price which the United States paid for like ordnance; payment should be made two-thirds in cash, the rest in eight per cent Confederate bonds; guns and carriages must be ready by April first.

The spring of 1861 was a busy and an anxious time for these border works. In March Southern railways having begun to revive, six Tredegar puddling furnaces were rekindled, the rolls put in action, and sixteen thousand railroad chairs made and shipped by April eleventh. The total force now amounted to nine hundred men, of whom five hundred and forty were employed in the foundries. All but the negroes, perhaps, were on tiptoe with suspense

for no man could count on Virginia's seceding—or not seceding. At last on Saturday, April thirteenth, came over the wires the news of the fall of Fort Sumter, and on April seventeenth the Convention assumed "the rights of Sovereignty" of Virginia.

The genius of Lee, Jackson, and others who now identified themselves with the Confederacy is known and recognized wherever history is studied, but the brilliancy of Confederate stars called on to perform great tasks behind the scenes has gone for the most part unrecognized, unknown. Josiah Gorgas, the quiet Chief of Ordnance, possessing a magic gift for organization; his subordinate, George Washington Rains, who created in the blockaded South the greatest powder mills in the world of his day; Stephen R. Mallory, the Secretary of the Navy, a man of wide horizon, of quick grasp of the important idea and tireless in his endeavor to make it concrete; John Mercer Brooke, an inventor of genius, chief of the group of naval officers whom the Secretary stimulated to construct ironclad ships, originate rifled naval cannon, torpedoes, and submaries; George Minor, who as Chief of Ordnance and Hydrography, organized the naval shops—these men worked on steadfastly, unobserved, unmoved by all the fevered restlessness of the outside world. And to this group belonged Joseph R. Anderson. For though never of the official family, he served the government in spirit and in truth. By the Administration's frequently repeated request, he remained a private manufacturer.

It is difficult to see how Gorgas and Minor without the aid of the Tredegar Iron Works could have established by 1863 a line of ordnance works from Richmond to Alabama. On July 18, 1861, the Secretary of the Navy stated that the officers in charge of the Norfolk Navy Yard had set in order and shipped from the stock there to important outposts in the Confederacy five hundred and thirty-three heavy guns. But until the mills and shops erected at Selma, Alabama, after war had started, began to produce cannon in 1863, Anderson and his partners cast practically all the heavy guns made in the Confederacy. By September in the early critical months they had furnished to the service seventy cannon exclusive of the guns which they had manufactured since January for the States. Between April, 1861 and 1865, they supplied nearly eleven hundred cannon to the Confederate cause. It may be said that it was due to Anderson and his partners that there was no lack in this branch of ordnance. But the manufacture of great guns was only a part of their contribution. The Tredegar Works in the spring of 1861 became the Confederate headquarters for scientific experiment. Here iron plate was rolled to create the first American ironclad; here possibly was built the first submarine boat engaged in warfare; here the first torpedoes, torpedo tanks, and chains were made; here were cast the first of the celebrated seven-inch Brooke rifled naval guns for throwing solid bolt shot, the Williams machine gun (possibly parent to the gatling guns of Doctor Gatling of Cincinnati, Ohio) and the iron Napoleons invented to replace bronze Napoleons when copper gave out in the Confederacy. The twelve great rolls and the heavier of the castings that equipped the Rains powder mill at Augusta were manufactured at the Tredegar. Most of the machinery with which Gorgas was manufacturing rifled muskets on a large scale at Richmond in November, 1861, was made at these mills and shops. To create new life in August, 1861, the Tredegar Works, Adam-like, surrendered a rib in the shape of a great Nasmyth steam hammer, the only steam hammer at that date in the Confederacy. Set up first at the Gosport Navy Yard where it made possible the manufacture of steam engines, the former Tredegar hammer was probably removed with the other machinery to the Navy shops at Charlotte, North Carolina, shortly before Norfolk fell in May, 1862. When the Confederate armory at Richmond was enlarged in 1862, the proprietors of the Tredegar helped to equip the extension with furnace plate, bed and boiler plate, patterns, and other castings. And to almost every war or naval shop which the departments organized from Richmond to Selma, Alabama, Anderson and his partners furnished some form of castings or rolling mill products, boiler plate and patterns, iron bar and spikes, while to the Richmond Navy Yards, created after Norfolk was evacuated, they sent boilers, flues, and cast iron propellers for gun boats, as well as much boiler plate. They were called on, also, to provide supplies for the auxiliary departments of the government works; for the Nitre and Mining Bureau, the Engineering Bureau, the Ambulance Service, and later for the Railroad Bureau. From the very beginning of hostilities, they supplied the rapidly organized Confederate laboratories with a stream of shells, shrapnel, and shot which they discontinued only when the Confederacy collapsed. They sent great quantities of bolts, projectiles, and other munitions to the Confederate military store. And throughout the war they never ceased to furnish supplies to the railroads and to a string of private customers, most of them engaged in government work, who were not confined to Virginia. With the Tredegar supplies went also at times mechanics trained at the Tredegar, worth their weight in gold to the organizers of the new shops and mills.

Apart from the one hundred and sixty-five powerful up-to-date heavy guns which the proprietors of these cherished works created between January, 1861, and the same month 1862, guns which the War and Navy Departments rushed north, south, east, and west to the most vulnerable parts of the Confederacy, their most dramatic work of the first year of war was the creation of the first American ironplated vessel to go into action, whose brief but murderous career set a quietus upon the world's wooden navies. Mallory, pondering in his bureau over the vast discrepancy between his resources and those of his adversary, Gideon Welles, the Secretary of the United States Navy, said publicly as early as May 10, 1861, "We must fight wood with iron."

As a former chairman of the Committee on Naval Affairs in the United States Senate, the Confederate Secretary of the Navy had gained valuable experience for the office which he held as long as there remained a Confederacy. He was familiar with the experiments of Robert L. Stevens in 1845 to construct an invincible floating battery; he knew of the effect of the American's theories on English and French naval experts now actually constructing iron fleets; and he saw that the time had come for him to put these toys of the brain to cold test. In perceiving that a fleet of wooden warships attacked by an ironplated vessel must be crushed like a lot of cockle shells, Mallory displayed an imagination superior to that of the "sea god" Maury's. The Virginian, Matthew

Fontaine Maury, knew that the Secretary had publicly advocated for the Navy Department the substitution as far as possible of iron for wooden vessels, yet he sent to the Virginian Convention a communication which recommended the immediate construction of a hundred wooden gunboats. When a man of Maury's marine experience adhered to the idea of the wooden vessel, which in one form or another had served efficiently since the days of the Greeks, it is not surprising that people ignorant of ironclads were instantly ready to champion his plan. The Convention, through one of its representatives, sent the Maury communication over to the Confederate Congress, and in spite of the Secretary's diplomatic opposition, a board of naval officers approved and adopted the plan on December 14, 1861. Thus, shortly before Christmas the Congress passed bills which authorized the construction of not more than one hundred small wooden gunboats, and appropriated two million dollars for the work. The Secretary managed before 1862 to secure authority to build a few iron gunboats, to cover with iron plates a former United States frigate called the *Merrimac*, and to construct at New Orleans an armor-plated ship on the order of the French ironclad, the *Gloire*. But his firm grasp of naval fact which repudiated wood for iron, was not permitted to dominate Confederate naval policy until the *Merrimac* in action proved to the world the futility of wooden ships.

The Secretary sent Lieutenant James H. North to London in May, 1861, to negotiate either in England or in France for two ironclad ships which the Congress had authorized. He did not wait, however, to hear from his agent or to gain the sanction of Congress to build an ironclad in the Confederacy. When the government moved to Richmond from Montgomery, the Secretary found a man of his own thinking and a brilliant aid in naval invention in Lieutenant John Mercer Brooke. The two held numerous discussions on the subject of ironclads, the result of which was that the Secretary on June tenth sent for Lieutenant Brooke and officially requested him to design an ironclad, and with the drawing to submit to him the specifications of the cost of the vessel.

In a few days Brooke brought back a drawing of a case-mated ship with submerged ends and inclined sides. The Secretary approved it, and since Brooke was not an expert draftsman, summoned from Norfolk a practical mechanic to make drawings of the vessel. When the mechanic appeared unequal to the task, the Secretary at Brooke's request called the chief engineer, William P. Williamson, and the naval constructor, John L. Porter, to come up to Richmond from the Navy Yard at Norfolk for a general consultation and to aid in the work. Porter brought a model of his own, a flat-bottomed, light-draft propeller, case-mated battery, with inclined iron of a thickness and angle of inclination that were nearly identical with that of Brooke's model. The Porter model did not embrace submerged ends, but both the constructor and the chief engineer approved of this peculiar and original part of the Brooke idea, which aimed to give speed and buoyancy, without exposing the hull, and to avoid increasing the draft of water. Porter, being a draftsman, made

Tredegar Iron Works, 1865 (River Side)

The building with the tall air furnace stack was the gun foundry and is now used for the manufacture of car wheels. On Brown's Island (left) the Ordnance Bureau of the Confederacy, under General Gorgas, maintained its filling and loading plant. Here, in 1863, a violent explosion killed many operatives including a score of women.

a clean drawing of Lieutenant Brooke's plan which was filed in the Navy Department, and Brooke and Williamson set out to find ready-made engines for the vessel.

Upon discovering no engines on hand at the Tredegar Works, Williamson evolved the idea of resurrecting and using the engines of the *Merrimac,* a United States vessel which the Federal troops had scuttled when forced to evacuate Norfolk. The engines had to be used on the *Merrimac* or a vessel of equal draft, and though Brooke and Porter thought the draft too great for the Brooke model, the three agreed that the plan was the best which fortune offered them. Porter, therefore, made another drawing, essaying to graft upon the *Merrimac,* the features of Brooke's ironclad. Mallory approved the adaptation, and, notwithstanding a lack of funds or the authority of Congress, plunged boldly into the work. Appointing Porter to reconstruct the *Merrimac,* he set Williamson to repair her engines; with J. R. Anderson and Company he made a contract by which they were to manufacture iron plates to form the vessel's shield; and when the Congress met in July, the former United States frigate *Merrimac,* lay in dry dock swarming with men. From all the rolls in the Tredegar mills, where work proceeded day and night, eight-inch iron plates, one inch thick, were being sent out under the expert inspection of Lieutenant Brooke. On the eighteenth of the month, the Secretary's report to the President announced his project along with the fact that work had begun upon it. He justified his act on the score of the precarious situation which required that no time be lost, and when presenting financial estimates computed by the various experts, tactfully stated why he included an estimate for plating with iron this hitherto distinguished wooden frigate.

The Secretary won an appropriation from Congress, but his mind which had dared to venture into the alien field of building iron ships never rested in attempting to discover whether the plan for the *Merrimac* might be accounted perfect. Thus in the midst of the work he withdrew Brooke from the Tredegar, and sent him to Jamestown Island to test the plates. Aided by a companion no doubt as interested as himself, Brooke set up a target inclined at an angle of thirty degrees with the horizon. The target, which he constructed in imitation of a broadside of the ironclad being built at Norfolk, had a base of wood twenty-four inches thick. Upon this wooden base the expert set, one on top of the other, three plates of iron, each plate one inch thick. Then standing at a distance of three hundred yards he fired into it eight inch solid shot, charged with ten pounds of powder. The shot pierced the iron and lodged five inches deep in the wood. Brooke, therefore, constructed a new target in which he secured a depth of four inches of iron by substituting two iron plates, each plate two inches thick, in place of the three one-inch plates. This he tested from the same distance with a similar charge of powder and shot, and also with nine inch shells, each shell weighing about seventy pounds and having a charge of ten pounds of powder. A number of tests demonstrated that the outer plate could be shattered and the inner plate cracked, but that the wood could not be reached.

On receiving Brooke's report the Secretary immediately ordered J. R. Anderson and Company to stop work on the one-inch plates and to make all plates, henceforth, two inches thick. The change caused some trouble and seriously increased the expense of the iron. For whereas one-inch plates could be speedily punched with holes necessary for future fastenings, the thicker iron had to be drilled. But the change was justified. The shot of the Federal champion, the ironclad *Monitor,* would undoubtedly have penetrated the three one-inch iron plates.

As the plates were finished they were shipped on "flats" to Norfolk under the watchful eyes of specially picked Tredegar employees. But so pressed were the railroads in attempting to meet the abnormal needs of war that often the iron destined for the *Merrimac* lay in great piles awaiting cars, and when finally shipped had to be sent on roundabout roads. A satisfactory arrangement was made about the end of November to send the iron by way of Weldon and over the Seaboard and Roanoke Railroad, and by February twelfth about one thousand tons of iron plates lay in Norfolk.

Almost every one knows the tale of the strange monster that on March 8, 1861, steamed straight from the hands of her creators into Hampton Roads, and into battle, and how her destruction there of the lofty frigates, the *Cumberland* of twenty-four guns and the *Congress* of fifty guns introduced a new epoch in the history of the world's navies. The *Merrimac,* or the *Virginia* as the Confederates had rechristened her, was armed with ten guns—four of them rifled Brooke guns, cast at the Tredegar. In her wake followed her little escort, the *Beaufort* and the *Raleigh,* each carrying one gun; and during the day while the ironclad was in action in the midst of the enemy's splendid wooden fleet, there came hastening out of James River to join her the *Patrick Henry* which the Tredegar Company in June had partially sheathed with iron and armed with six guns, the *Thomas Jefferson* with two guns, and *"the Saucy Teaser,"* a wooden gunboat with a single gun. The two latter boats had been prepared for war by Tredegar hands. In the evening after the iron sides of the *Merrimac* had withstood the hot shot and projectiles of a hundred cannon, the little fleet steamed triumphantly back to anchor near Norfolk.

But the Federal Navy Department had not been idle. Sometime after the Confederates had begun work on the *Merrimac,* the United States Government entered the race to complete an ironclad. When the Confederate champion sallied forth on March ninth she was challenged by a small queer craft of little more than a quarter of the *Merrimac's* weight and with a draft of water hardly over one-half. The newcomer had two eleven-inch Dahlgren guns in her revolving turret, and people at the time described her as looking like a "cheese box on a plank." This boat, the famous *Monitor,* was the invention of John Ericsson who, nearly two decades before, had sent from New York to the Tredegar Works for strong iron for his marine experiments. After twice escaping shipwreck on her voyage from New York, the *Monitor* had reached Old Point Comfort at ten o'clock on the night of March eighth. The two ironclads now met in the shock of battle which, after four hours of almost continuous fighting, failed to give decisive victory to either champion.

What happened thereafter has not yet been satisfactorily settled. The *Merrimac* on March eighth had left her iron beak in the side of the *Cumberland* and during the battle her injuries received the previous day began to be evident to her officers although not to the enemy. The two boats returned to their respective harbors and on March eleventh the *Merrimac* went into dry dock for repairs. The Tredegar

people responding to orders, hurried down additional iron plating and seventeen pairs of iron shutters. They also sent bolts to be used in her guns instead of projectiles.

On April eleventh the champion steamed out equipped as she had first been intended to go into battle. Her draft was so great that she would have been but a helpless floating battery at the mercy of wind and tide if she had attempted, with a view of bombarding Northern parts, to go out into the open sea. Until the eleventh of May she cruised over Hampton Roads, where she captured three transports and defied the Federal fleet. The *Monitor* did not again come out to meet her. McClellan had begun the Peninsular Campaign and when the Confederate military authorities, not naval authorities, decided that Norfolk must be evacuated, the *Merrimac's* own crew destroyed their ship which no longer had Norfolk as a base and was too unwieldy to be piloted up James River.

Had the *Merrimac-Virginia* been supplied with bolts instead of projectiles when the *Monitor* challenged her, it was the belief of the expert Brooke that her guns would have disabled the *Monitor's* turret, and on March ninth have won a decisive victory. The order for bolts to be made at the Tredegar gave way to work which the government at the time appeared to need more urgently.

(Part II of this article will be published in the Jan.-Feb. issue)

Who's Who in This Issue

CAPT. ELLIOTT SNOW, Construction Corps, U. S. Navy, author of "The Battery of 'Old Ironsides'," is one of the high-ranking officers of that Corps. In 1906-7 he was closely identified with the restoration of "Old Ironsides," a work which was carried out under a provision enacted by the 59th Congress, 1st session, 1905-6. What Captain Snow says in his article is taken from his personal files, and although popular in style it represents first-hand information technically and historically accurate as to detail.

* * *

With the national budget holding the center of attention throughout the country, the paper by Maj. Gen. Kenzie W. Walker, Chief of Finance, U. S. A., on "The War Department Budget" is both timely and significant. A graduate of the Military Academy, class of 1893, and of the Army War College, 1921, General Walker has had a long and conspicuous military career. As Chief of the Finance Service, he is among the best qualified officers of the Department to discuss the meaning and operation of the War Department budget. We feel confident that his article will attract a great deal of interest.

* * *

The Tredegar Iron Works at Richmond, Va., now in its 90th year of ordnance manufacture, holds a unique place in America's munitions history. Its importance in the War for Southern Independence is the major theme of the article by Miss Kathleen Bruce, Ph. D., Professor of History at Wheaton College. Dr. Bruce has made extensive researches into the economic phases of the Civil War, and her paper, "Economic Factors in the Manufacture of Confederate Ordnance," is replete with data which are at once fascinating and instructive. Part II of this article will appear in the January-February issue of ARMY ORDNANCE.

* * *

Complementing the viewpoint of General Walker, the article by Col. James L. Walsh, Ord. Res., on "Economics of National Defense" should prove of great value. As Chief of the New York Ordnance District and as one of the most ardent proponents of industrial preparedness in this country, Colonel Walsh possesses military and civil experience which add greatly to the authenticity of his work. As first Secretary of the Army Ordnance Association and Editor of this journal, his remarkable record will long be remembered. His article was presented as an address before the American Bankers' Association in Des Moines last June.

ARMY ORDNANCE has the rare privilege of publishing in this issue, articles over the names of two of its former editors. Maj. R. H. Somers, Ord. Dept., U. S. A., who succeeded Colonel Walsh as Secretary and Editor, presents in his paper, "Machine Tools and Munitions," a clear and concise discussion of an important phase of industrial preparedness. Major Somers was intimately associated with the makers of machine tools during the World War when his assignments in the Ordnance Department brought him into daily contact with that industry. It was therefore extremely fitting that Major Somers should address the members of the National Machine Tool Builders' Association at their recent convention in Washington, D. C. His article is for the most part taken from the address which he delivered on that occasion.

* * *

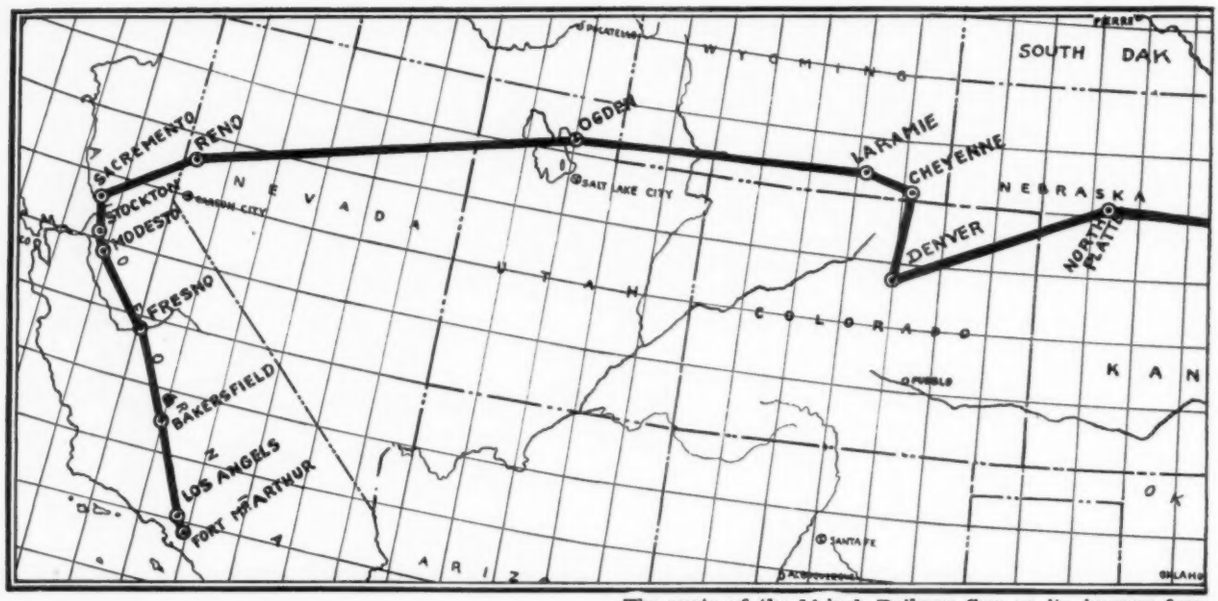
The remarkable record of Frankford Arsenal ammunition at the International Matches at St. Gall, Switzerland, during the past summer, together with an account of the picturesque setting of the matches, is described by Maj. Julian S. Hatcher, Ord. Dept., U. S. A., who was Adjutant of the American team. Major Hatcher has long been identified with small arms activities in this country and is now stationed at the Frankford Arsenal.

* * *

Maj. Calvin H. Goddard, Ord. Res., in his paper, "Forensic Ballistics," describes one of the most interesting practical applications of ordnance technique developed in recent years. We feel certain that those of our readers who are particularly interested in small arms, their history and development, will find in the researches described by Major Goddard a very practical and scientific solution of a problem which has confused and often times frustrated our foremost criminologists. We feel particularly grateful to Major Goddard and his associates for the privilege of publishing his paper since this is the first formal presentation of these data in American literature.

* * *

Messrs. H. H. Lester and R. H. Aborn present in this issue Part II of their exhaustive investigations on "The Behavior Under Stress of the Iron Crystals in Steel." As previously announced in this place, Mr. Lester is research physicist at the Watertown Arsenal Laboratory, and has done pioneer work in the radiography of metals. Mr. Aborn was formerly research assistant at the Laboratory. Part III of this article will be published in the January-February issue of ARMY ORDNANCE.



The route of the 14-inch Railway Gun on its journey from

Giant 14-Inch Railway Transcontinental

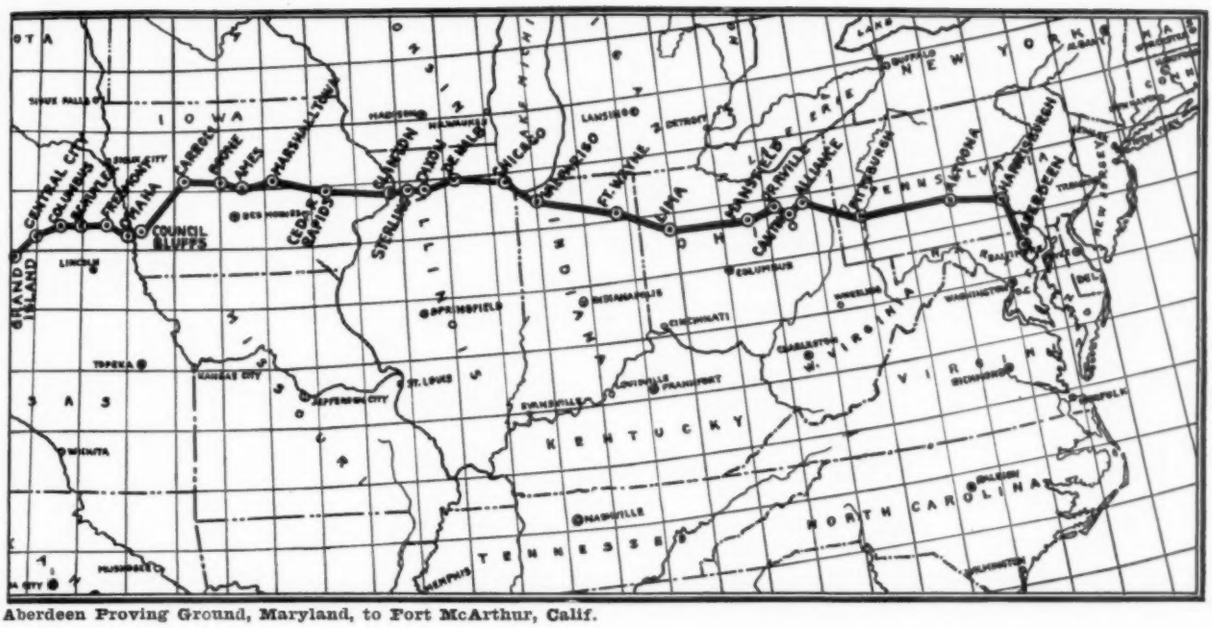
THE largest piece of mobile ordnance produced in the United States since the World War began its transcontinental service test when the 14-inch railway gun, Model 1920, left the Aberdeen Proving Ground, October 19th, en route to Fort McArthur, California.

The test has been planned by the coöperation of the Chief of Engineers, the Quartermaster Corps, the Coast Artillery Corps, the Ordnance Department, and the railway systems of the United States, and is being executed under the supervision of the Chief of Coast Artillery. Major Harold E. Small, 52nd C. A., is in command of the convoy, assisted by Captain F. J. Fitzpatrick, 52nd C. A., Ordnance Machinist Edward E. Rosolie, Sergeant Wm. Bryster, Battery D, 52nd C. A., and Corporal Glenn O'Donald, Battery D, 52nd C. A.

The route, with principal stopping places, is shown on the map above. From the Proving Ground to Chicago the gun is traveling via the Pennsylvania Railroad; from Chicago to Council Bluffs via the Chicago and Northwestern; from Omaha to Ogden via the Union Pacific System; from Ogden to Fort McArthur via the Southern Pacific.

Railway guns came into general use during the World War and the designs of this particular gun and carriage began in 1919 and were completed in 1921. There is nothing unusual about the cannon itself, but the carriage represents a marked advance over the World War types.

The 14-inch Railway Mount Raised to Firing Position at 0 degrees Elevation.

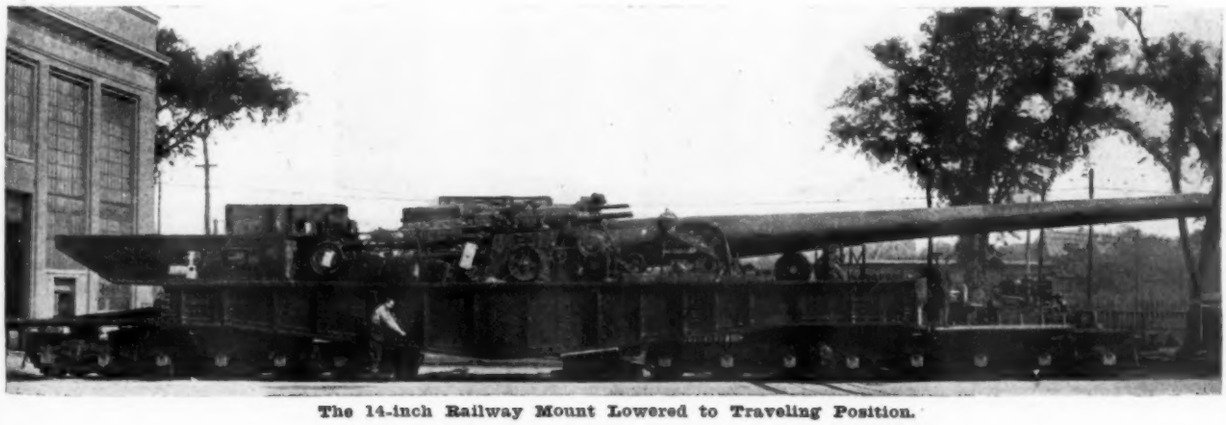


Aberdeen Proving Ground, Maryland, to Fort McArthur, Calif.

Gun Now Undergoing Service Test

The unit has been under test and modification at Aberdeen for over two years. The first phase of the service test is purely a transportation test, as the movement of a piece of ordnance with the weight and dimensions of this unit is a serious problem for the railroads. Mounted on four trucks with a total of fourteen axles, the complete length of gun and carriage is 95 feet 4 inches, height 14 feet and width 10 feet. Yard facilities, bridges, especially covered bridges, tunnels and snow sheds have been given particular consideration in planning the transportation test. The speeds are to be those usually employed in the movement of freight traffic. A crew of 200 men will normally be required to serve a battery of two such guns in battle. The unit has self-contained electrical and compressed-air equipment to facilitate operation of the carriage. It is estimated that the gun can be placed in firing position with a traverse of 7° under field conditions in less than two hours, and emplaced on a previously prepared concrete emplacement to permit traverse of 360° in an hour. From latest reports the gun is standing the test in a most satisfactory manner.

In its trip across the continent this unusual piece of ordnance is passing through sections of the country where many of the people are unaccustomed to weapons of these dimensions. The large numbers of inquiries and the huge crowds which have visited the gun at its several stopping places thus far are indication of popular interest in this major item of the national defense.



The 14-inch Railway Mount Lowered to Traveling Position.

Economics of National Defense

By

Col. James L. Walsh, Ord. Res.
Chief, New York Ordnance District

WE Americans are a peace-loving people. We cherish no dreams of conquest; we nurse no smoldering fires of revenge. "Live and let live" has been and always will be the inspiration of our foreign policy. But our love for peace has not, of itself alone, kept us out of war. Against our will, and in spite of the fact that for nearly two years prior to the declaration of war we had exhibited the utmost patience toward all the belligerents, we were drawn irresistibly into the vortex of the greatest and most terrible conflict in all history.

Our digression from the paths of peace was not of our own choosing. Diplomatic representations, vigorous protests, even lightly-veiled threats—all were without avail. A long series of grievous wrongs had to be righted and, all other means failing us, we righted them as we had righted other great wrongs in our history—by force of arms.

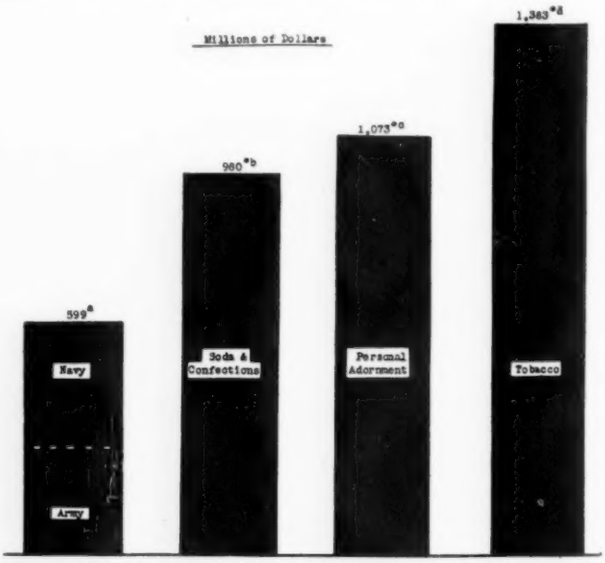
There are those who say that we need not have actually used our arms or our army, had we been properly prepared to back up our representations. The dynamic force arising from actual employment in battle would not have been needed, had we possessed the static potential of adequate armament and sufficient personnel trained in its use. General Pershing has given it as his fixed opinion that, "if America had been adequately prepared, our rights would never have been violated, nor our safety threatened."

Whether proper preparedness will enable us honorably to avoid future wars is, of course, an academic question. There is this to be said, however. Appeals to reason, pleas for justice, moral suasion, accompanied by praiseworthy exhibitions of patience, a desire for peace, and every other Christian virtue, signally failed to keep us out of the World War, and we paid for participation in the sum of 22 billions of dollars, 230,000 wounded, 50,000 killed in action. We bet 22 billions of dollars that our policy of unpreparedness would keep us out of the war—and we lost.

Ignorant, as we are, of what the future holds in store for us, it cannot be stated with absolute assurance that any degree of preparedness, however great, will operate to keep us forever out of war. We do know this, however. The strong nation, like the strong man, is less liable to wanton attack. Furthermore, the length of time required to effect a decision in our favor would be shortened in direct proportion to the time required to mobilize our man-power and industrial resources for the national defense.

If we accept the conclusion, which seems to be a reasonable one, that some degree of preparedness is necessary, provided we wish to "secure the blessings of liberty to ourselves and our posterity," we are at once confronted with the problem of determining what constitutes reasonable preparedness.

Our program of National Defense connotes, at this juncture, no thought of slumbering designs against our peace on the part of any nation or group of nations. To justify measures of national defense, it is no more necessary that we specifically nominate a possible aggressor nation, than that a bank should specify by name the burglar against whose depredations it erects its vaults and maintains its watchmen. We arm against affront from whatever quarter it may be offered us, meanwhile prayerfully hoping that serious invasion of our rights will never be attempted.



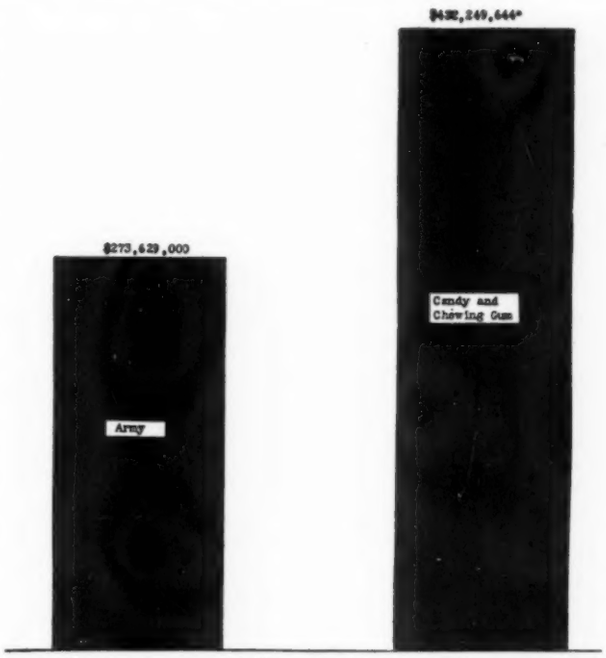
Expenditures for national defense versus estimated expenditures for certain non-essential manufactured products of the United States—1923.

*Value of product at factory plus tax collections; does not include wholesalers' and retailers' profits. a. Inciudes $273,629,000 for military purposes and $325,309,000 for naval purposes for Fiscal Year 1923. b. Value of soda and appliances, Ice Cream, Confections and Chewing Gum manufactured in 1923, excluding establishments whose products were valued at less than $5,000. c. Value of perfumery and cosmetics, jewelry and silk manufactured in 1923. d. Value of cigars, cigarettes, chewing and smoking tobacco and snuff manufactured in 1921, and value of pipes, cigar and cigarette holders, and cigar boxes manufactured in 1923. Excludes establishments whose products were valued at less than $5 000.

However, it is a fact not to be dismissed lightly that improvements in transportation, particularly the airplane, have appreciably lessened the isolation which we seem always to have considered as rendering us relatively immune to attack from abroad. Further, we are competing for world trade with other nations to a greater and greater degree. In this connection, the United States Department of Agriculture is authority for the statement that "Future generations will see a world shortage of wheat unless rational land and population policies are formulated by the white

race." This prediction is based upon the known fact that the white races of the world, who are the principal consumers of wheat, have at present an annual requirement of 2,500,000,000 bushels. If the white race increases in population as at present indicated, this annual requirement will amount to 3,200,000,000 bushels in twenty-five years; 4,300,000,000 bushels in fifty years; 5,800,000,000 in one hundred years. Should the average per capita consumption increase to that now prevailing in France, which is indicated as being almost a certainty on account of increasingly higher prices of meat, the white races will require 5,500,000,000 bushels annually within the next fifty years. Inasmuch as the world today can produce only from 3,000,000,000 to 3,500,000,000 bushels a year, it would appear that the instinct for self-preservation will eventually cause struggles between nations for the additional land needed to sustain their growing populations. Of course these direful conditions may be obviated provided we are able to increase the supply of other food products, or develop new sources of sustenance, but, for the long pull, conditions certainly point toward increasing pressure upon nations to extend their land areas in the interest of their own preservation, and this expansion of territory will obviously be attempted at the expense of those nations which control the world's wheat-growing areas.

The insistent cry of the pacifist to outlaw war and abolish armies is itself good evidence of the existence of potential causes of war. In this uncertain period, we find ourselves the richest nation in the world, with a correspondingly great responsibility arising from our leadership in world affairs. We are a stabilizing influence on international relations, just as a large bank is a stabilizing influence in the local business community. We owe it to civilization to neglect no proper measures which would tend to increase our standing and our influence for the good in the great family of nations. A small bank can fail without causing more than a localized ripple in financial circles, but the collapse of a great national banking institution would affect the entire structure of the nation's business. Similarly, a small state can disintegrate and disappear without appreciable injury to other countries, but the collapse of a great state such as ours would inevitably bring down with it countless others and cause immeasurable damage to civilization generally.



Expenditures by the United States for military purposes versus estimated expenditures in the United States for chewing gum and candy—1923.

*Value of product of factory plus tax collections; does not include wholesalers' and retailers' profits. Also excludes chewing gum establishments whose products were valued at less than $5,000.

Viewed in this light, national defense becomes nothing less than a plain moral duty, for the proper performance of which history will inevitably hold us of this generation responsible.

It is important to distinguish between the cost of war and the cost of national defense in time of peace. The cost of war corresponds to our huge annual loss from fire; the cost of national defense corresponds to what we spend for fire insurance and fire prevention. In both cases, it is a question of paying out a relatively small sum annually, or of running the risk of taking an enormous loss when the calamity is upon us. We cannot buy insurance when the conflagration threatens; and we cannot purchase national security when the emergency is at

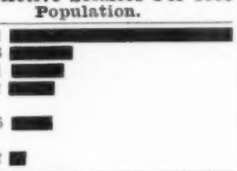
Financial and Military Statistics of Certain Countries—Fiscal Year 1923-1924—Estimated, Showing Population, Wealth, Revenue, Size of Army, Military Expenditures, etc.

NATION	Population	Wealth (Thousand Dollars)	Revenue (In Local Currency)	Strength Active Army	Military Expenditures (In Local Currency)
Russin	132,000,413	60,000,000	1,616,000,000 gold roubles	700,000	313,000,000 gold roubles
France	39,280,345	58,500,000	21,521,000,000 francs	752,000	3,661,201,324 francs
Japan	58,841,500	43,000,000	1,376,172,969 yen	250,000	196,990,000 yen
Italy	38,835,941	21,800,000	20,362,791,723 lire	200,000	3,350,000,000 lire
Great Britian and Ireland*	47,365,000	70,500,000	865,196,664 pounds	161,600	64,092,802 pounds
United States	112,078,611	320,803,862	3,894,677,000 dollars	141,859	245,216,630 dollars

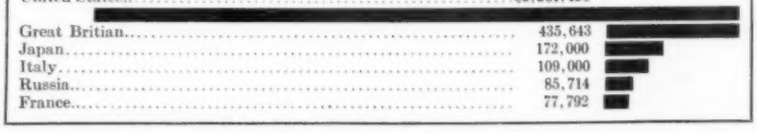
*Does not include the British Empire.

Military Expenditures in % of Revenue.

No. of Active Soldiers Per 1000 Population.



National Wealth Per Active Soldier.



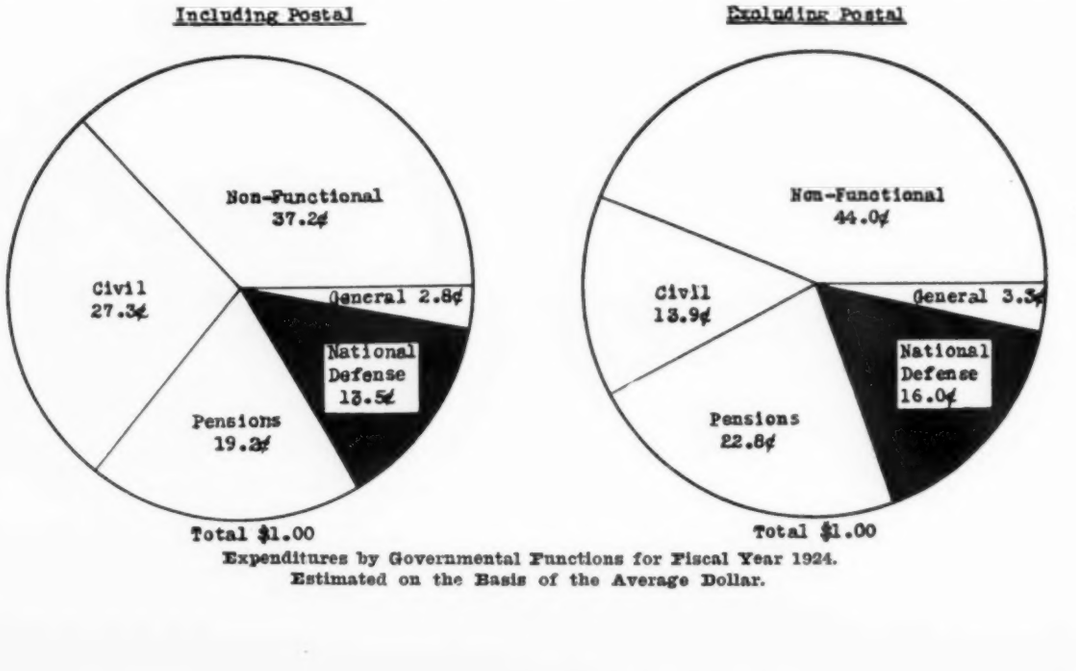
hand. During the World War, Congress could and did appropriate billions of dollars; but it did not and could not appropriate a single second of time. From the date of our entrance into the World War for a period of over two years, our war expenditures averaged over a million dollars an hour—a total of 22 billions of dollars, not including an additional 10 billions which we loaned to the Allies. Crowded into the short space of two years, we spent more money than the entire cost of running the United States Government for the 126 years from the time of its inception up to the time of the outbreak of the World War.

In considering current expenditures for this purpose it is important to bear in mind that one of the compelling reasons for effecting the Union of the Thirteen Original States was "———— to provide for the common defense———." The language of the Constitution leaves no doubt that the Federal Government was devised primarily to insure cooperation in defense against common enemies, and, at that time, it was generally accepted that the preponderant part of Federal appropriations would very properly be devoted to providing adequate national defense.

For the last full year for which complete figures are available, the War Department appropriations totalled $335,000,000. Considered by itself, this is a tremendous amount of money, but the total Federal Budget for that year was over $3,600,000,000. Deducting $78,000,000 for river and harbor improvements and other purely civil activities administered by the War Department, leaves about $257,000,000 devoted to purely military purposes or only 7 per cent of the total budget. Apparently, we are even less militaristic than the founders of our government had every reason to expect would be the case. Incidentally, we spend six times as much for soda and candy as we spend for purely military purposes; for tobacco four times as much; for perfumery and jewelry five times. For all our national petty vices, we habitually spend eighteen times as much as we pay for the insurance policy on our national existence. Apparently, we can afford to pay the existing rates, in fact, we could pay many times as much with only a proportionate decrease in the amount of candy we eat, or the tobacco we smoke, or the cabarets we attend, as the price for additional national security. It is perfectly true that this cost is greater than it was ten years ago. Even if it has doubled in the meantime, our national wealth has likewise doubled. Incidentally, ten years ago, our expenditures for national defense were about one-fourth of the entire national Budget, today they are but little over one-eighth of the total expenditure, so that the ratio of cost of national defense to the whole national budget has really decreased by nearly one-half, and this, in spite of the fact that every item that goes into the cost of a modern army or navy has considerably increased in the meantime.

Our Regular Army has directed the manpower of the nation in six major wars and more than one hundred minor disturbances, minor only in the sense that the enemy was less powerful than ourselves and the ultimate sovereignty of the Nation was endangered to a lesser degree. In addition, the Army has given us what might be called "by-products of national defense" in the shape of valuable contributions made by its personnel toward national progress along other than military lines. The Lewis and Clark Expedition which spent two years in surveying the lands acquired by the Government through the Louisiana Purchase was a Regular Army contribution toward expansion of our territory. Army engineers helped to project, to build, and to operate many of the early railroads, not only the great transcontinental lines, but also several of the earlier Eastern roads such as the Baltimore and Ohio; the Erie; the New York, New Haven, and Hartford; and the Boston and Albany. Army engineers surveyed and marked practically every boundary of the United States and most of the State boundaries. They helped to build the Chesapeake and Ohio Canal, the Erie Canal, and, more recently, the Panama Canal. They surveyed our Great Lakes, built lighthouses to make navigation safe and increased the depth and width of the channels of commerce in all the important harbors of the country.

The Army Ordnance Department as early as 1798 was responsible for establishing the principle of interchangeability in manufacturing muskets for the Army, and developed the whole theory of standardization upon which our quantity production of such articles as automobiles,



Expenditures by Governmental Functions for Fiscal Year 1924.
Estimated on the Basis of the Average Dollar.

typewriters, and sewing machines is based today. The Army Ordnance Department in seeking to obtain a better quality of gun metal developed nickel steel and other high grade metals and alloys now in general use commercially. Even as late as the World War the Army Ordnance Department's research and investigation as to the possibility of manufacturing high-speed tractors for hauling heavy guns over broken ground has reverted to the general benefit of all who utilize adaptations of these devices in agriculture, lumbering, mining, and similar industries.

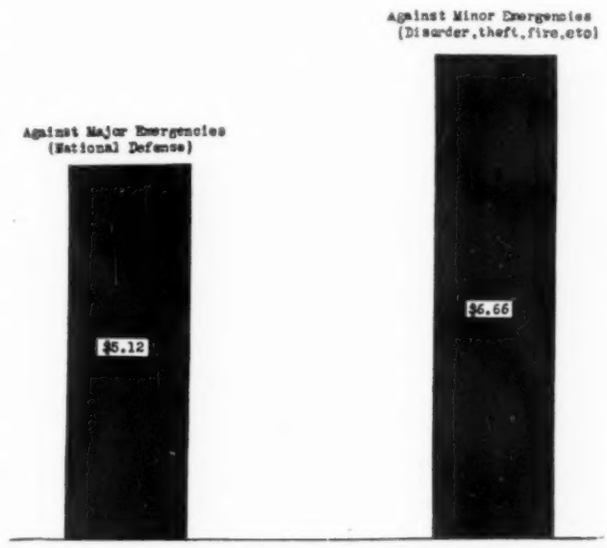
The Army Air Service has undertaken research and developmental work which would be beyond the resources of any commercial organization, and placed the results of its activities at the disposal of the commercial airplane manufacturer, with consequent advantage to business in the shape of Air Mail Service, and the possibility of satisfactory and reliable aerial express service.

Our great telegraph systems of today received impetus from the work of the Army Signal Corps in erecting military telegraph lines during the Civil War. As late as 1877, it was handling more than 3,000 miles of telegraph lines in the South which form the framework of the commercial systems now used in that section. In the field of radio, an Army Signal officer invented, among other outstanding contributions in this field, the loop which has so generally superseded the cumbersome outside antennae and which has made possible the general use of receiving sets in the restricted quarters of the average American home.

The Army has rendered valuable help during great civil emergencies such as the San Francisco earthquake of 1906, the Ohio and Mississippi floods of 1912, the Galveston flood of 1915, and the continuing helpfulness which it extends even today in the Territory of Alaska in protecting settlers, building roads and railroads, and operating telegraph and radio facilities which connect us with this isolated empire of ours in the far Northwest.

The Army Medical Corps has eliminated the hookworm disease, stamped out yellow fever in the tropics, controlled malaria, and more recently has banished typhoid fever, the great scourge of armies from time immemorial. Even as late as the Spanish-American War, twelve percent of our soldiers were stricken with typhoid fever; during the World War only about one-twentieth of one per cent were infected. The humanitarian activities of the Army have not been restricted to America alone. From the beginning of the World War in 1914, American relief for the stricken people of Europe was largely administered by the Army.

But, neglecting all considerations of gratitude for past accomplishments, and discounting all probabilities of the Regular Army being able to make, as it has in the past, valuable by-product contributions to our national progress, let us examine the facts with a view to ascertaining whether there is an economic justification for spending on national defense the amounts of money which our military advisors tell us are necessary.



Expenditures for National Defense versus Expenditures for Protection of Person and Property—1922.

The expenditures of the United States for National Defense in the year beginning July 1, 1922, amounted to $599,750,232, or $5.12 per capita. The expenditures of all cities of the United States of 30,000 population and over for protection to person and property in the year beginning January 1, 1922, amounted to $257,877,000, or $6.66 per capita. Thus, the average citizen of one of these cities pays $1.54, or 30% more for protection against minor disturbances such as disorders, theft, fires, etc., than he does for protection against major disturbances involving the life of the nation such as attack by a hostile nation or insurrection.

In considering the cost of supporting our present military establishment, let us take its value as insurance of the permanent maintenance of American institutions as the sole criterion of its usefulness. Just as in a financial statement we eliminate good will wherever possible, so we must eliminate from our minds any gratitude for past accomplishments of the Army in making, extending, and preserving the Nation. Bankers like to feel that they are able to pierce the haze of sentiment which surrounds a given situation and get at the real facts of the case; in other words, to "see the figures." More than that, to compare one set of figures with another — quick assets with quick liabilities; this year's earnings with those of previous years; this company's balance sheet with others in the same line of business. In making decisions, dependence is placed not so much upon absolute quantities, as upon relations between quantities, ratios or percentages.

First remember that the United States of America is the richest nation in the world today, and inquire as to whether the amount we are spending for the protection of our national wealth is disproportionate when considered in relation to that expended by other nations. The following are figures reduced to the common basis of soldiers maintained in active service per hundred millions of national wealth:

Russia maintains 1,818 soldiers per hundred millions of national wealth; Italy, 1,300; France, 848; Japan, 800; Great Britain, 240; Germany, 118; United States, 44.

If we maintained a standing army based upon the amount of wealth protected, according to foreign standards, we would maintain between one and two million men constantly under arms.

There is another ratio which is equally interesting—that of military strength on the basis of population:

France maintains 1,590 soldiers for each 100,000 of population; Italy, 964; Great Britain, 874; Russia, 429; Japan, 422; Germany, 158; United States, 125.

It is worthy of note that, in proportion to population, the United States is maintaining a smaller army than Germany, although the army allowed Germany by the Treaty

of Versailles was definitely intended to render her impotent from a military point of view. In this connection, it is also worth noting that, according to population, we maintain the smallest standing army of any of the fifty principal countries of the world.

It might also be interesting to compare our cost of national defense with that of other nations. The following table will indicate the proportion of total governmental revenue expended for military purposes in the principal nations of the world:

Russia	19.48%
France	16.57%
Japan	13.18%
Italy	9.41%
United States	8.25%
United Kingdom	5.48%
Germany	5.48%

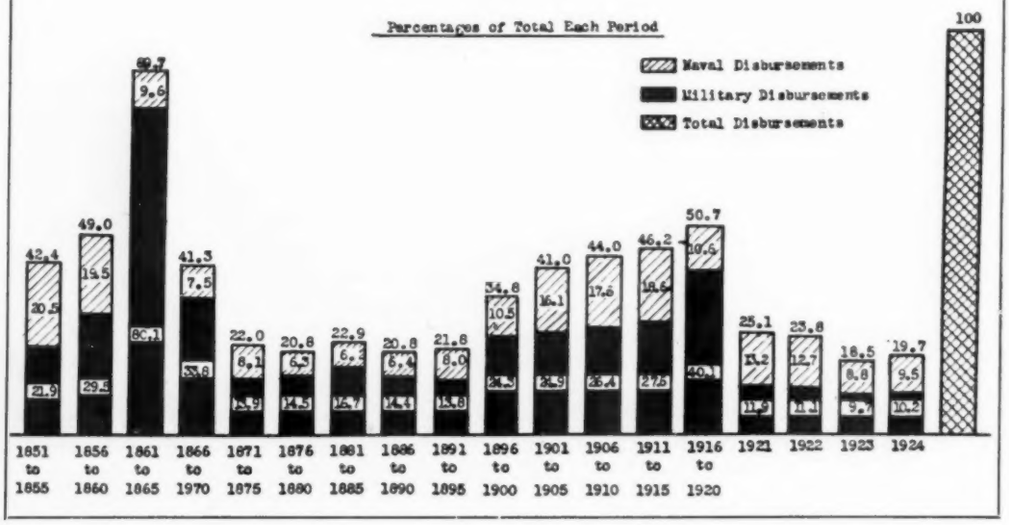
In appraising the relative values of these figures it should be borne in mind that the American Army is relatively better paid than that of any other country. The minimum pay of an American private soldier is $30 per month, whereas in countries where compulsory military service is an institution, the private soldier's pay is as little as 6 cents per day in Japan and 4 cents per day in Italy.

To sum up, we are the wealthiest nation in the world today; yet we maintain the smallest standing army in proportion to our population and national wealth. We are embarked on a great adventure—in faith—to determine whether we can for very long remain weak, wealthy,—and SAFE.

Military and Naval Disbursements vs. Total Disbursements of the United States, 1851-1924. (Source of Information: Treasury Department)

YEARS	Military Disbursements* Amount***	Military Disbursements* Per Cent of Total Disbursements	Naval Disbursements Amount***	Naval Disbursements Per Cent of Total Disbursements	Total Disbursements** Disbursements for all Gov't Purposes. Amount***	Military, Naval Disbursements in Per Cent of Total Disbursements
1851-55	$ 56,492	21.9	$ 52,988	20.5	$ 257,876	42.4
1856-60	101,349	29.5	66,982	19.5	343,754	49.0
1861-65	2,738,763	80.1	326,650	9.6	3,418,927	89.7
1866-70	639,078	33.8	141,915	7.5	1,888,211	41.3
1871-75	200,930	13.9	116,637	8.1	1,437,298	22.0
1876-80	185,850	14.5	79,951	6.3	1,277,991	20.8
1881-85	215,049	16.7	79,316	6.2	1,288,456	22.9
1886-90	200,426	14.4	89,360	6.4	1,395,670	20.8
1891-95	251,630	13.8	145,923	8.0	1,817,996	21.8
1896-1900	556,389	24.3	240,428	10.5	2,287,255	34.8
1901-05	666,811	24.9	431,435	16.1	2,677,796	41.0
1906-10	845,252	26.4	564,360	17.6	3,195,888	44.0
1911-15	993,961	27.6	670,310	18.6	3,601,263	46.2
1916-20	16,713,006	40.1	4,420,004	10.6	41,713,833	50.7
1921	580,795	11.9	647,871	13.2	4,891,275	25.1
1922	402,059	11.1	458,795	12.7	3,618,038	23.8
1923	355,723	9.7	322,533	8.8	3,647,648	18.5
1924	348,606	10.2	324,130	9.5	3,404,295	19.7

*Includes Military Establishments; Fortifications, etc., Panama Canal; U. S. Military Academy; National Guard; National Cemeteries; National Homes for Disabled Volunteers; Trust Funds; Monuments; War Claims; Rivers and Harbors, etc.
**Includes all disbursements shown by Treasury Department.
***000's omitted.



Seventh Annual Meeting
of the
Army Ordnance Association

WERE you there? If you were, you already know that the seventh annual meeting of the Army Ordnance Association at the Aberdeen Proving Ground, October 2nd, has passed into history as one of the most successful demonstrations of progress toward adequate National Defense. Beginning at 10 A. M. and continuing without interruption until 7:30 P. M., the program of demonstrations was one of the most interesting and best conducted in the history of the organization.

The Commanding Officer of the Proving Ground and his staff are to be congratulated upon the efficient execution of the entire program. The local forces were assisted by organizations from the Second and Third Corps Areas, including Battery C, 62nd Coast Artillery, the First Battalion, 6th Field Artillery; the 1st and 30th Ordnance Companies, and detachments of Air Service and Chemical Warfare Service troops. The band of the 6th Field Artillery gave two concerts during the day and the Signal Corps provided the service of the Mobile Public Address System, which made possible the broadcast of descriptions of the various events to the two thousand spectators present.

In addition to the membership of the Army Ordnance Association, invited guests included the National Aeronautic Association, the National Machine Tool Builders' Association and the Franklin Institute of Philadelphia. Other groups which attended in a body were the entire inspection force of the Bureau of Explosives, New York City, the Pennsylvania Section of the American Society of Automotive Engineers, and many members of the 79th Division with headquarters in Philadelphia.

For the benefit of those who were not present, and in order that there may be a complete chronicle of the happenings of the day, this record of proceedings is given:

Promptly at 10 A. M. opening exercises of the day were conducted at Mulberry Point, where the guests were welcomed by Lt. Col. C. M. Wesson, Commanding Officer of the Proving Ground. Then followed a program of firings with the 3-inch antiaircraft gun, Model 1918, conducted by Battery C, 62nd Coast Artillery (A A) from Fort Tilden, New York. The firings were made against a sleeve target towed by an airplane. When the target was brought to the ground it revealed that of a total of some 125 shots there were 29 punctures in the fabric. Without going into a technical discussion as to the average of hits, suffice it to say that the record was a most commendable one and made an excellent impression upon all who witnessed it.

Followed firings of the 14-inch gun on disappearing carriage and the 16-inch gun on Barbette carriage, Model 1919 MI. This latter is the largest weapon constructed for seacoast defense in this country. It has a maximum range of over 30 miles using a powder charge of 860 pounds.

The next demonstration took place at the aviation field where military and commercial aircraft and the various types of bombs manufactured by the Ordnance Department were on display. Here also a smoke curtain, one of the recent developments of the Chemical Warfare Service, was laid down by a Martin bomber equipped for this purpose. There was also an exhibition of parachute jumping by Air Service personnel stationed at the Proving Ground.

Luncheon was served at noon at the Service Club and was followed by a band concert and several short addresses by prominent guests. Hon. Benedict Crowell, President of the Army Ordnance Association and former Assistant Secretary of War, first introduced Col. John Q. Tilson, Representative in Congress from the Third District of Connecticut. Colonel Tilson said, in part:

"Mr. Crowell has been good enough to present me to this audience as the father of industrial preparedness. If I am entitled to this honor I can only say that I certainly have some very efficient and enthusiastic sons, beginning with Mr. Crowell and including all those who are giving of their time and efforts to adequate national defense. These include the members of the Army Ordnance Association and the other organizations which are participating in this meeting, and all others who give their energy and enthusiasm to this worthy cause.

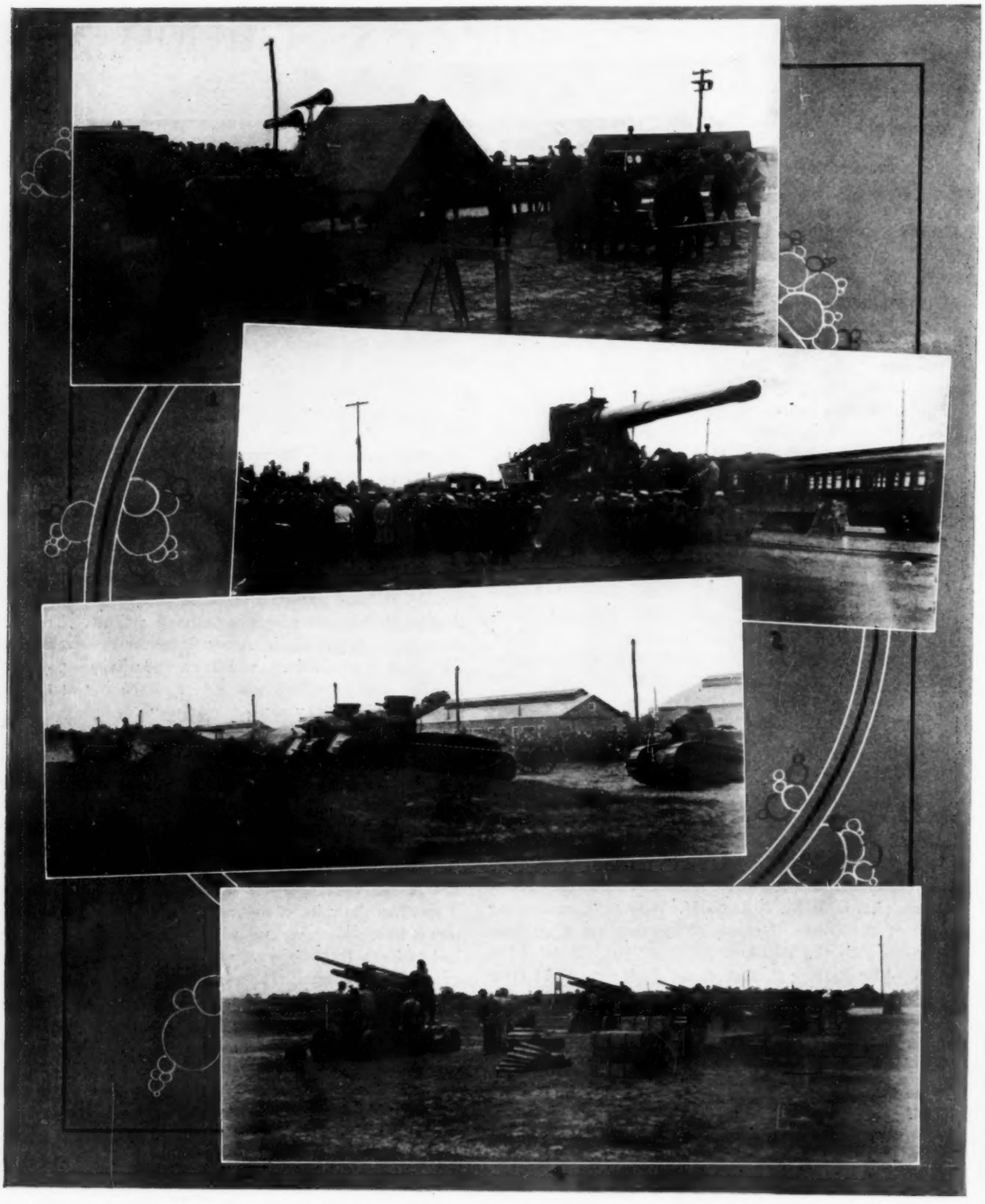
"I feel that the Army Ordnance Association is to be sincerely congratulated upon the great showing it has made here today. That so many men of affairs from all sections of the country assemble here annually with the officers of the Army is to be greatly commended and it augurs extremely well for the national defense of our country.

"When I began to interest Congress some sixteen years ago in the vital necessity of adequate industrial defense it was like the voice of one crying in the wilderness. That was a long while ago and when the World War came we had to learn the lesson very rapidly and under some very great disadvantages. The results are well known to all of us: the lesson was only partly learned and in many cases it was learned in vain. Today it is beginning again to be forgotten and we are going back into the same fool's paradise in which we existed before the war.

"This meeting to my mind is ample indication that you patriotic citizens of the country are going to see to it that we do not step back into the same position we occupied before the World War.

"As a Member of Congress I cannot make any promises as to what the action of that body will be in years to come. For the present we must leave to the Appropriations Committee of the Congress and to those who appear before that

Scenes at the Seventh



1. **Antiaircraft Range-finding Devices.** 2. **14-Inch Gun on Railway Mount.** 3. **Tanks and Tractors in Automotive Demonstration.** 4. **Battery C, 62nd Coast Artillery preparing to fire at sleeve target.**

Annual Meeting, A. O. A.

1. Aircraft on exhibition at Aviation Field. 2. Foreground: 1st Battalion, 6th Field Artillery firing shrapnel; background: Effect produced by smoke bombs dropped from airplane. 3. 1st Battalion, 6th Field Artillery in action. 4. Sound locating instruments used by 62nd Coast Artillery in antiaircraft firings.

"Among those present" at the Seventh Annual Meeting of the Army Ordnance

Committee the course of action which will be pursued. I will say, however, that the things for which we expend such appropriations as Congress may make should be those which are as nearly permanent as possible so that at the end of the year we will have either trained personnel or material to be handed on for the future. Let everything that is expended be used for something that is as nearly permanent as we can make it. That should be the cornerstone of the policy of the Army and if those who have to appear before the Committee can make good their requests you may count upon my assistance anyway and I am sure you will have the hearty coöperation of the Congress.

Mr. Crowell then presented Mr. Godfrey L. Cabot, President of the National Aeronautic Association, who said:

"The National Aeronautic Association was organized for the safety of this country by promoting aviation. Most of the men of the Army Air Service and the head of the Naval Bureau of Aeronautics have often emphasized the fact that a great reserve force of skilful flyers in this country serves as a reservoir from which the Army and the Navy can obtain the men needed to defend our shores. There is one peculiar feature of the air defenses as applied to the geographic situation of this country. As we have no boundaries adjacent to great nations with whom we are likely to be engaged in war, and as we are separated by oceans east and west of us, this country is more powerful as an element of defense than as an element of aggression. Therefore, by sharing the privileges of this organization it is possible for every citizen of these United States to aid in the peace and safety of their country without any danger of exciting suspicion or jealousy on the part of any foreign nation.

Mr. William C. L. Eglin, President of the Franklin Institute of the State of Pennsylvania, said, in part:

"The Franklin Institute welcomes this opportunity to join the Army Ordnance Association in taking part on this most important occasion.

"The Institute, as you may know, was founded to promote mechanical art. We have had lots of opportunity today to see the importance of mechanical art in warfare.

"The Franklin Institute is interested in the promotion of mechanical arts not only but also does a great deal of research work. The essence of real preparedness is in being up-to-date and even in being ahead of the rest of the world. Therefore, the Franklin Institute appreciates this opportunity to join with you and to place anything we may possess at the disposal of the Government at all times."

Mr. O. B. Iles, President of the National Machine Tool Builders' Association, also addressed the gathering and congratulated the Ordnance Department and the Army Ordnance Association on the excellent work being done for national defense. He pledged the hearty co-operation of the machine tool builders of America and expressed the hope that more of that group might have occasion from time to time to see the advancement in munitions' design and manufacture as conducted by the Ordnance Department.

Maj. Gen. Charles P. Summerall, Commanding General, Second Corps Area, who closed this portion of the meeting, said:

"It is a very great privilege to speak today for the Line of the Army and thank Mr. Crowell and the Army Ordnance Association for what its members are doing for national defense.

"We feel that one great field of endeavor that would be most effective is the organization of the resources of our country for the defense of our nation in time of war. We realize that in placing the industries of America at the dis-

Association, Aberdeen Proving Ground, October 2, 1925.

posal of the military arm the greatest step possible is being made in the preparation to avoid war in the first place and to bring war to a successful conclusion should it come upon us.

Immediately following these addresses demonstrations of ordnance mobile repair shops were given by the 1st Ordnance Company (Maintenance) from Miller Field, Long Island, and the 30th Ordnance Company (Heavy Maintenance) from Camp Meade. Both of these organizations had previously made the journey overland from their respective stations and had the various equipment on exhibition and in operation.

The Ordnance Company (Heavy Maintenance) handles major repairs for which the equipment of the Ordnance Company (Maintenance) is inadequate.

The trucks in this unit include a 3-ton truck chassis F. W. D., Model B-1917, and an artillery repair truck body, Model 1918, mounted thereon.

There are two kinds of trailer units, the 4-ton shop trailer, Model 1918, and the 10-ton trailer chassis, Model 1918.

The other units include: Air compressor truck, power saw truck, tool room truck, spare parts truck, office truck, bar stock and hacksaw trailer, parts and stock room trailer, parts and stock room bin trailer, drill press trailer, generator trailer, lathe trailer, milling machine trailer, welding and forge trailer. The heavy repair shop is equipped to make all major repairs in the field.

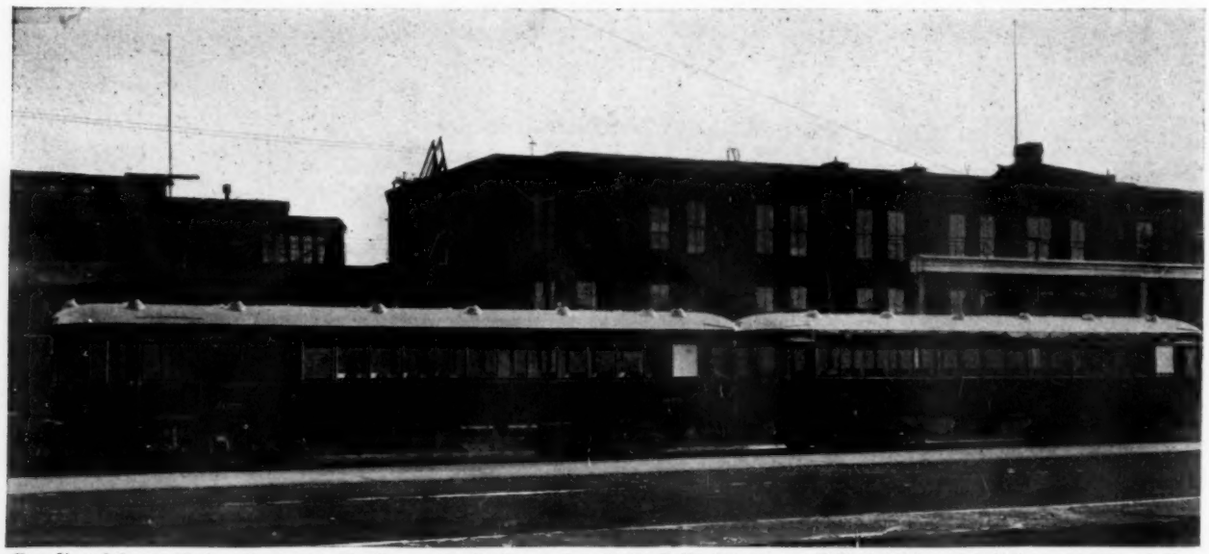
At 1:30 P. M. automotive demonstrations were begun at the main front. These included exhibition and maneuver of tanks, tractors, motor gun carriages, and cross-country passenger and cargo vehicles. The 6-ton tank with Kegresse-Hinstin tracks was the center of attention during the tank demonstration. This is the standard type of light tank used in the service with the exception of the tracks which are experimental. The vehicle weighs 6 tons and is armed with either the 37-mm. gun or the caliber .30 machine gun.

Other tank demonstrations included the Mark VIII tank with stroboscope, a Medium Tank, Model 1921 and Model 1922. The tractors demonstrated included the 2½-ton, Model 1918, with modified cooling system; the 2½-ton, Model 1918, with Liberty truck engine, towing 1½-ton trailer; the 5-ton Artillery tractor, towing 155-mm. howitzer and limber; the 10-ton Artillery tractor, towing 155-mm. G. P. F. gun; the Holt T-35 tractor, towing ¾-ton trailer, and the Pavesi and International Harvester tractors. The Fordson tractor was exhibited with Johnson track-pull adapter, towing 75-mm. gun.

Motor gun carriages on exhibition included the 75-mm. gun, Mark VI, the 155-mm. gun, Mark IX, and the 240-mm. howitzer (St. Chamond), Mark IV and IV-A.

In the demonstration of cross-country passenger and cargo vehicles the Citroen cross-country car with Kegresse-Hinstin adapters, and the modified Ford cross-country car came in for a major share of interest. It is now under test at the Proving Ground to determine its utility in the transportation of personnel and cargo across country. It is also being tested as a tractor for the 75-mm. gun. The modified Ford car has already been described in these pages. The Dodge car with Chase track and the six-wheel Dodge with four-wheel drive were also demonstrated.

At 2:30 an exhibition of bombing was given by a Martin bomber which dropped 600-lb. demolition bombs for land



Gasoline-driven Motor Car and Trailer manufactured by J. G. Brill Company, Philadelphia, in which members of the Pennsylvania Section, American Society of Automotive Engineers, traveled to Aberdeen Proving Ground for the Meeting.

impact. Bombs of this kind are intended for use in attacking storehouses, terminals, supply depots and similar targets. Smoke bombs were also dropped to illustrate their use in forming a smoke screen. Chemical Warfare Service troops then gave a demonstration of smoke screens using the 4-inch trench mortar. They also laid down a large area screen using 300 smoke candles.

Then followed one of the most spectacular demonstrations of the day when the 6th Field Artillery from Fort Hoyle, Maryland, maneuvered into position, registered on a target with shrapnel and put down a smoke barrage.

The small arms demonstration began at 3:15 and included firings of the caliber .30 and caliber .50 armor-piercing bullets against tank armor.

Firings of mobile artillery which were the next event on the program included the 37-mm. gun, Model 1916, firing supersensitive fuzes against airplane fabric; the 75-mm. gun, Model 1916, on self-propelled mount, Mark VII; the 105-mm. howitzer, Model 1920; the 75-mm. gun, Model 1897, firing black service and flashless powder; the 3.3-inch gun which was fired for stability, and the 75-mm. gun, Model 1897, which fired an outline trajectory. This form of trajectory was shown by firing a series of rounds of shrapnel with time fuzes set at 2-second intervals to function simultaneously.

The visitors then visited the Exhibition Building where various types of war matériel and damaged guns and photographic displays of ordnance operations were on exhibition. Here the Gage Section, Office of the Chief of Ordnance, under the direction of Col. J. O. Johnson, Ord. Res., had arranged a most interesting exhibit of the manufacturing gages required in the production of 75-mm. ammunition.

The Mobile Public Address System, Signal Corps, U. S. A., through which addresses and descriptions of the demonstrations were broadcast.

Here also the Edgewood Arsenal had on exhibition various items of equipment manufactured by the Chemical Warfare Service. Much interest was exhibited in the latest type gas mask which is considered by many the most efficient equipment of its kind in the world.

The seventh annual business meeting of the Army Ordnance Association was held at 5:30 P. M., in the auditorium of the Administration Building. Mr. Crowell presided. A verbatim account of the proceedings follows:

Mr. Crowell: "The meeting will please come to order. This is the Seventh Annual Meeting of the Army Ordnance Association. The first order of business is the report of the Secretary, Major R. L. Maxwell."

Major Maxwell: "Gentlemen, the report of the Secretary is informal. The salient facts of the history of the Association during my brief tenure of office, which has been since the first of July, have been that each month upon receiving a report from the Secretary for Membership, I have been able to take the pin out of the membership curve and move it up.

"The finances of the Association are in very favorable condition at the present time. The magazine, ARMY ORDNANCE, we are very proud to say, has a number of subscribers in addition to the membership of the Association.

"I should like to add that as Secretary of the Association it is a very great pleasure to me to have the coöperation and assistance of the members individually, the local posts, and especially the Proving

The Ordnance Gage Exhibit showing gages used in the manufacture of a complete round of 75-mm. ammunition. This display was the center of much interest for members of the National Machine Tool Builders' Association.

Ground, in making the detailed arrangements for today's meeting."

Mr. Crowell: "Gentlemen, the membership of the Association is now some 2,500. It is, in a sense, a civilian reserve for the Ordnance Department. I take pleasure in presenting to you General C. L'H. Ruggles, the Assistant Chief of Ordnance, whom we are always glad to have with us for our meetings."

General Ruggles: "Members of the Army Ordnance Association: You are all familiar with the motto of your Association, 'Pledged to industrial preparedness for war as our strongest guarantee of peace.' That epitomizes the purpose of the Army Ordnance Association. We are very fortune in having men such as Mr. Crowell, who was our Assistant Secretary of War during the World War, as President. His interest in the Association is an inspiration. Only yesterday he came down to the Ordnance Office when we were having a very difficult problem and spent the morning helping us out.

"Now industrial preparedness is not the only form of preparedness because it consists largely of planning, but in our country particularly it is the most effective form of preparedness against war. There is no question as to the quantity of our manpower, and this last war and all other wars have shown that there is no question as to its quality, but manpower **without** munitions is, of course, in this day of scientific warfare, helpless. On the other hand, our manpower granted, if we have adequate munitions preparedness so that we can furnish munitions to our own troops at a greater rate than our enemy can furnish munitions to its troops, you can rest assured that no country in the world will venture to attack the United States.

Ordnance Mobile Repair Shops manned by the 1st and 30th Ordnance Companies in operation at the Meeting.

"Now the Army Ordnance Association, as Mr. Crowell very well said, is one of several reserves to the Ordnance Department. We have, of course, the Regular Ordnance Officers—about 300—and we have about 2,400 Ordnance reserve officers, and then we have the members of the Army Ordnance Association. By bringing to its annual meetings each year prominent men such as we have today and will have next year and so on, it is the greatest possible help in explaining to our people what ordnance preparedness means, the difficulties in producing these munitions, and the manner in which they are used.

"I feel very certain that the effect of the Association and of our district chiefs in taking up the industrial preparedness work with the various manufacturers in their districts is very great indeed. This is entirely voluntary on the part of the manufacturers and the district chiefs.

"ARMY ORDNANCE—the official journal of the Association—is also very helpful to us. It constantly tells what we are doing, explains the need for the work we are doing, it arouses the interest and familiarizes people with the work we have under way so that when we approach them in this matter of industrial preparedness we will have a very favorable response.

"When the industrial preparedness **movement** was started it seemed impossible that we could arouse the interest of the manufacturers as we have done. The interest they take in the work, the time they give to it, the planning of what they will do, is very

much more extensive than we had hoped for and is indeed most gratifying. Of course this is largely due to the personal interest of our district chiefs, men of success and ability in the community.

"We hope to see the membership of this Association increased from year to year, and we all appreciate the real worth of the motto and the real power behind that motto. I believe we have had today the most successful gathering we have ever had. We are particularly pleased in having with us the visiting associations so that they may see what work we are doing and planning.

"I want to thank the Army Ordnance Association for bringing these societies together, for the great effort they have made, the trouble they have taken. The exhibits were most interesting, and I particularly want to thank the Commanding Officer of the Proving Ground and his staff for their part in the success of the day."

Mr. Crowell: "I am going to call on General J. W. Joyes, the Chief of the Technical Staff, Office of the Chief of Ordnance, for a few words."

General Joyes: "It is a most significant thing to me to see the large and intelligent assemblage of men here to give of their time to attend these annual meetings of the Army Ordnance Association. When we remember that they are outside their daily occupation and life work such interest is a concrete demonstration that, should we unfortunately again have a war, we will be in an altogether different state of preparedness from that in which we entered the World War. The state of unpreparedness for the last war was appalling. We were unprepared in every conceivable way and the lack of a plan and any cohesive thought as to what we would do was beyond comprehension. Now I think the difference between our present state and that which existed before the World War is one upon which every American citizen ought to congratulate himself.

"We have here at the Proving Ground an establishment which I believe is one of the most interesting anywhere to be found. It includes a variety of work at once intensely practical and interesting. Oftentimes we fall short of attaining the objective we hope for, but if it were not so it would be that much less interesting.

"I trust that all of you who are here today have enjoyed the program and have found some interest in it. For myself, I find that these gatherings grow more interesting from year to year."

Mr. Crowell: "At my right is Mr. W. W. Coleman who has been Vice-President of the Association since its organization. Mr. Coleman."

Mr. Coleman: "Mr. President, gentlemen. May be because of the fact that I come from Wisconsin I am going to strike a note which is perhaps more pessimistic than that of the previous speakers. It has been extremely pleasant to hear their optimistic reports of what has been and is being done.

"In the last decade or so there have been two, at least two, outstanding acts of Congress placed on the statute books. One of these is the Federal Reserve Act. It took us a number of decades to acquire the Federal Reserve Act. I think that it can be said safely that it has been tested and demonstrated as one of the most satisfactory laws we have ever had. It has taken us 150 years to get the National Defense Act on our statute books. That Defense Act has not yet had an opportunity to be demonstrated. I am inclined to think—I hope I am wrong—that it will fail unless something is done promptly. Of course talking in the presence of so many Army Officers I am not saying anything new in saying that the National Guard has not by any means reached its quota under the Defense Act, that the Organized Reserve has not nearly approached what it will be.

"The Army Ordnance Association has made great progress, but I bring this matter up to emphasize that there are only a few organizations in our country today which have a definite program and desire to see the fulfillment of the intentions and purposes of the National Defense Act. Therefore I want to appeal to you particularly, members of the Army Ordnance Association, to realize so far as possible the great opportunity and the value of such a program as ours in opposing, so far as it lies in our power, the forces that are operating to see that the Defense Act is a failure.

Mr. Crowell: "You have all heard of the Ordnance District Chiefs and of the fine work they have been doing in industrial planning. Col. C. L. Harrison is Chief of the Cincinnati District and a Director of our Association. Col. Harrison."

Col. Harrison: "The District Chief must know a great many things, if he doesn't know he has to find a man who does know.

"The work of the District Chief is very large, covering as it does all kinds of manufacture. I was one of the original district chiefs appointed in 1918 and in the succession of the short years have been on the job ever since. We have a meeting in Washington once a year and sometimes oftener. The Army Ordnance Association I consider in the district work my second line of reserve, the reservoir from which advisory talent and working talent can be secured in filling my own position which, in case of emergency, will be a very large one. In the last war I had about 2,200 in the organization.

"The machine tool industry has been my pet hobby and I am very glad to see the machine tool men here and to witness the great interest they took in the demonstrations of the day. The work of the district chief would be impossible if it were not for the backing of the Department in Washington. They tell us what ought to be done and they leave us alone. If we fail it is our own fault."

Mr. Crowell: "In closing I wish to thank Colonel Wesson and all the members of his organization for the efficient program of today, and in looking forward to seeing you all again at our next annual meeting, I wish you all a happy and prosperous year."

The night program which began immediately after supper included firings of caliber .30 and caliber .50 tracer bullets, ground pyrotechnics and airplane signals and flares. There were also firings with the 3-inch field gun using night tracers, and of the 155-mm. gun, G. P. F., using flashless, nonhygroscopic powder.

The program was brought to a close with a spectacular exhibition of firings with the Livens projector using white phosphorus-filled shell, and of white phosphorus hand grenades.

It was the unanimous opinion of all who attended the seventh annual meeting that it was the largest in point of attendance and the most interesting program of demonstrations and exhibits in the history of the Association.

Machine Tools and Munitions

By

Maj. R. H. Somers, Ord. Dept., U. S. A.

IN ANY consideration of reasonable measures of preparedness the machine tool problem is one of first importance. The production of munitions for modern warfare not only requires machine tools in large quantity, but in great variety, some of which must be of extreme accuracy. The United States has but recently emerged from an international contest which has borne home to all thinking men the necessity of industrial as well as of military preparedness. It was Napoleon who said that "An army marches on its belly." It also fights with tools and those tools, with the advancement of civilization, are becoming more and more complex, more and more difficult to provide, and more and more important to the human machine. David, with his sling, had no difficulty in finding an abundance of ammunition furnished freely to his hand by nature. Physical man has changed but little, if at all, since David's time, but his weapons and his ammunition are incomparably more difficult to procure and to use.

Maj. R. H. Somers, Ord. Dept., U. S. A.
Assistant Ordnance Officer, First Corps Area.

A well balanced national industrial preparedness is today one of the strongest guarantees of peace that a nation can possess. If we are prepared, and known to be prepared, a marauding country in search of a greater place in the sun, coupled with an easy conquest and a rich reward, will look elsewhere than toward the United States for its victim. Furthermore, if we should come to some great difference of opinion with another nation or people over principles which to each seem vital to its own future or the well being of the whole world, we shall be able to produce when needed the munitions necessary to bring victory to our arms.

Soldiers are no longer confined to the front line trenches. Their tools are not machine guns and rifles, aircraft and bombs alone. Our armies now comprise our whole industrial population as well as our uniformed fighters, and in the catalogue of instruments of war must be included lathes and planers, drill presses and screw machines and every other bit of equipment which assists the industrial army to perform its part.

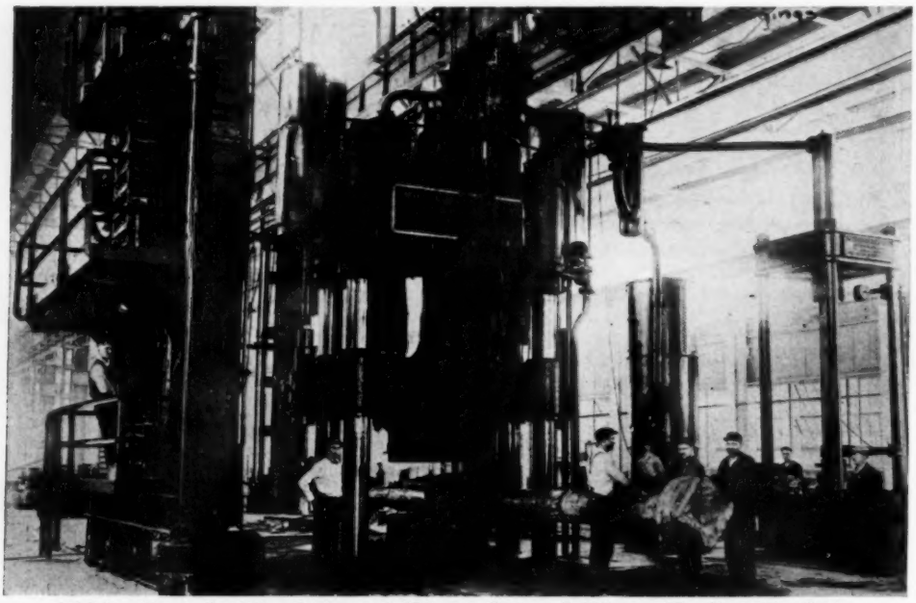
When, unhappily, the United States is again confronted by a war emergency of major dimensions, nothing can be more certain than that, as in the World War, the machine tool industry will have thrust upon it a load of tremendous proportions. The demands for machine tools, jigs, fixtures, gages, dies and shop equipment in general will be far beyond the possibility of immediate supply. What steps should the United States and the machine tool industry reasonably take in time of peace in order that the problem, when it presents itself, may be met in a sane, common sense manner? The object to be secured is not the most complete and detailed solution possible from the theoretical standpoint, but the most practicable one from the work-a-day point of view.

In many ways our next war will differ from the World War and the machine tool problem will have a correspondingly different solution. Some of the differences will be in our favor and some will be against us. Naming the principal differences only and the adverse one first:

a. We will not have an enormous and firmly established munitions industry already in being in this country. Far from finding our industrial facilities already producing munitions in large quantities for countries which are to become our allies, we shall probably be in a worse condition even than we would have been in June, 1914, before war orders from European sources had stimulated our production. At that time there were a few munitions works well established in this country, such as the Bethlehem and Midvale plants and a number of small arms cartridge plants. Outside of certain makers

of explosives and small arms cartridge plants, operating on a very small scale, there is today practically no munitions industry in existence in this country nor is there any prospect that any will be established.

b. We may not again have the benefit of allies already engaged in holding the enemy back while we prepare to enter the fray. Time in that case will be very much more of the essence of munitions production.



2000-ton Press for Manufacture of 155-mm. Gun and 240-mm. Howitzer Forgings. American Bridge Company, Gary Plant, Gary Ind., May, 1918.

c. We will not be able to borrow from allies completely developed designs of material in production elsewhere. (This, however, may not be entirely a disadvantage since foreign production methods differ so radically from our own that the difficulty of getting a foreign design into production in this country is practically as great as the work of bringing out an entirely new design of our own after the experimental and development stages have been passed.)

On the other hand there are a number of ways in which we shall be better able to supply munitions in the future than we have been in the past:

a. For the time being at least, we have large reserves of ammunition and equipment. Our equipment reserves are unbalanced and we are lacking in certain important items. Our ammunition reserves are being depleted due to target practice expenditures and unavoidable deterioration in storage, but what we have represents an improvement over our previous condition.

b. We have in an advanced stage of completion improved designs of ordnance material of all important kinds. These designs, for the most part, are past the experimental stages. Manufacturing tolerances and limits have been set and engineering drawings and specifications are in process. In this work we are having splendid coöperation and assistance from the industrial world. We believe that, as far as can be done in time of peace with the personnel and funds available, we are making excellent progress towards a condition of readiness for the production of advanced types of ordnance material.

c. Through the operation of the district system, war orders are being placed for our munitions requirements with the manufacturers who will actually make them in time of war. These manufacturers are making tentative production studies, which in many cases include the preparation of factory plans, route sheets and bills of material, and are getting in a position to go ahead promptly on the outbreak of war. Being business men accustomed to the exercise of acute business foresight, they see the wisdom of their present efforts and expenditures and, when war becomes imminent, they will undoubtedly take action to meet the approaching emergency on their own responsibilities without awaiting the formal and official word from the War Department. This in itself would result in a tremendous advantage to the United States without in any way embarrassing our diplomatic situation prior to the formal declaration of hostilities.

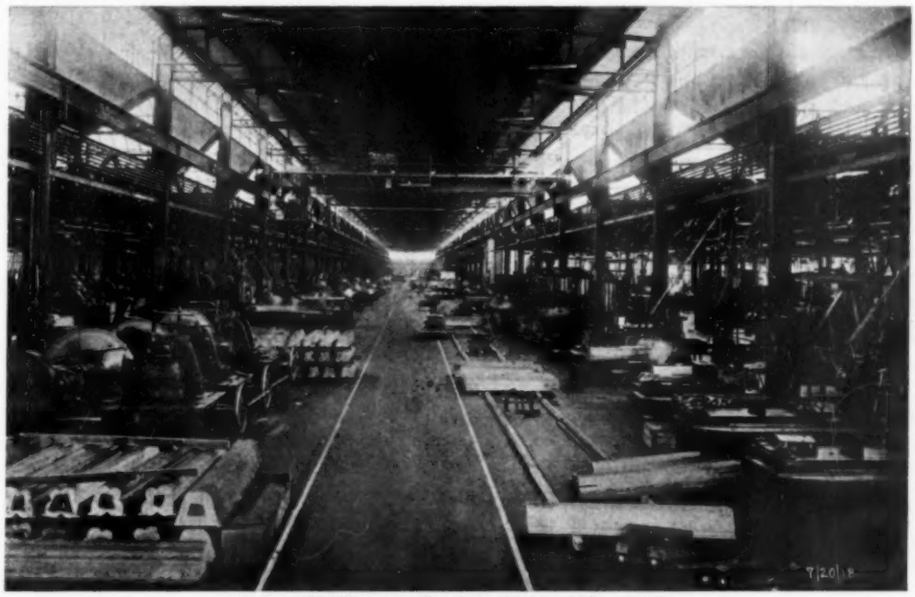
In considering machine tools from the ordnance standpoint, it must be borne in mind that the nation's machine tool requirements in war are by no means confined to the needs of the Ordnance Department or even to the joint needs of the War and Navy Departments. The ordinary every day existence of our people must be kept up as well as may be under war conditions. The whole industrial life of the country will be quickened by the indirect as well as the direct war load. This means that while the ordinary demands for machine tools may be curtailed, perhaps greatly curtailed, they cannot be eliminated. The machine tool industry must face the war load for the greater part as an additional burden to its normal peace-time load.

It is clear that every effort must be made to utilize for the direct production of munitions every available piece of manufacturing equipment. Expansion of facilities, inevitable though it will be, must be kept to the minimum. It is to be feared that a dispassionate study of the situation which obtained during the World War would show that an enormous effort was expended on the manufacture of facilities which had better been directly expended on the manufacture of munitions. This is said not by way of criticism. It was the inevitable result of entering upon a war of major effort almost without plan, either military or industrial. Incidentally, as events have turned out, you will perhaps agree with me that far too many machine tools were built during the war.

Of course, no possible plan can anticipate exactly all conditions and contingencies which will confront our country in the event of war. But the present Basic Mobilization Plan represents what is believed to be a reason-

able plan for our preparedness based on a fair study of the possible situations with which the United States may be confronted.

Under the assumptions of the Basic Plan, it is merely a matter of computation to obtain for each ordnance item a schedule showing month by month the amounts which should be available for troop supply. Without going into detail, it may be stated that these amounts have been worked back into terms of factory deliveries. In a great measure, as previously stated, "war orders" have been placed with manufacturers for their production. It is not until war orders have been placed that it becomes possible to get an estimate of our machine tool requirements. This is a matter of determining exactly what additional equipment each contractor requires and totaling this for all of our war orders in order to determine our total machine tool needs.



Dodge Brothers Ordnance Plant, July, 1918.

These needs may be met either from new production or from surplus machine tools available elsewhere in the country. There is at all times a certain amount of shop equipment which is idle. In the aggregate the total becomes large. Then, too, a certain amount of surplus equipment will be created by the war emergency itself. Plants converted from a peace to a war basis will find their equipment out of balance for the new work, and will have equipment for which they have no further use. The conservation of material and of manpower will result in the more or less drastic curtailment of less essential industries and release much equipment for war work.

Surplus equipment is the quickest source of supply for the war plants. By giving adequate publicity to the Government's needs, by suitable "propaganda" if you please, much of this could be discovered and made available exactly as was done in the case of field glasses and other articles during the World War. It is, of course, impossible to gather any real statistical information as to the total amount of equipment which might be thus secured, but there is no doubt that it is large.

But it is not safe to depend for our supply of munitions for our troops at the front on a potential supply of equipment which may or may not become actually available in time of war. Accordingly we are proceeding on the basis of considering existing equipment only insofar as it is actually available to the contractor either in his own plant or otherwise at his command. The indefinite potential pool of surplus equipment mentioned above will be available and without doubt will be needed to take care of those war agencies which will have to be created at the time to meet the exigencies of the situation and of the general industrial expansion incident to all wars. The War Department cannot afford to take any chances in its program for munitions production.

In many cases the contractor will need little or no new equipment or the new equipment required will be in the nature of dies, jigs and gages. This is the case where the nature of the matériel to be manufactured is similar to that made by the contractor in time of peace. In other cases, and this is especially true where ammunition is concerned, entirely new plants will have to be constructed. The manufacturer can bring over from his commercial plant little beyond experienced personnel and a going organization.

I want to emphasize the fact that the computation of machine tool and related requirements necessarily follows that of munitions proper. For this reason, it must be the last part of our requirements program to be completed. Considerable progress has been made in the work in the several Ordnance Districts and it is hoped that the initial survey will be completed during the present fiscal year.

It is when we attempt to control the distribution of the available production of machine tools to individual plants that our most serious difficulties begin. There are two ways in which the question of this control might be approached. On the one hand we could build up a highly centralized control with card indexes and a complete system for clearing all requirements, handling the distribution very much as a train dispatcher handles his trains. On the other hand we may decentralize the control as far as practicable, depending upon securing a reasonably satisfactory distribution by less exact methods and with a great deal less administrative machinery. The former method is alluring to the mathematical mind and might work out very well in some countries. The experiences of the World War seem to indicate very clearly that the American people in time of war can be handled more effectively by methods which are less mechanical and more direct.

The so-called "gasolineless Sundays" will illustrate

what I mean. There is no doubt that we could have secured something measurably like the same result by card index and police control methods. But it would have taken a multitude of clerks and officers to have carried out the proposal, the administrative machinery would have been ponderous and slow, much resentment would have been stirred up, and the results secured would have been much less effective than was the simple request of the Fuel Administrator backed as it was by a thoroughly determined public opinion.

It is among the men immediately engaged in manufacture that the intelligence and skill necessary for the organization and operation of our war industry are to be found. The problem of war production from the War Department point of view, therefore, resolves itself into so organizing our efforts as to utilize to the best advantage the skill, energy and ability already existing in the industry and with the smallest possible disturbance of the existing economic structure. This is best accomplished by decentralizing to the greatest practicable extent toward the men in the field. The chiefs of the several supply branches have done this to a high degree in the fourteen procurement districts by delegating responsibility and authority to the chiefs of those districts. These chiefs have nothing to do with the determination of the procurement program but they are given a very definite schedule of material for the procurement of which they are responsible with specified times for its delivery. Each chief in turn allocates to manufacturers within his territory definite amounts of this material for production and thus secures a further decentralization.

A manufacturer having secured from his district chief a prime contract must look to means for its accomplishment. General practice in this country in manufacture, both in peace and in war, is to place sub-contracts, or purchase in the open market, machines and other equipment, raw materials, semimanufactured parts, complete components, etc. The agency best able to determine the proper course of action in each individual case is the prime contractor himself. It should be left to him as far as practicable to determine not only what machines he desires to use, but to decide where these machines can be secured.

The contractors through their engineers and purchasing agencies have in the aggregate information regarding the possible supplies of machinery, tools, raw material, etc., that could never be reduced to an inventory or card index, regardless of the efforts that might be expended thereon, and our plans for assisting the contractor in securing his material and equipment must keep this basic fact in mind.

Furthermore, there are in this country also a vast multitude of small shops, many producing high grade manufacturing specialties which would perhaps be overlooked in a survey by a central survey organization, or which if used at all would probably be very ineffectively used.

The initial step in the solution of the problem comes from the contractor having a war order when he lists his requirements for additional plant equipment required under his order. Opposite each item of equipment required, he places the name or names of those firms which, in his opinion, can most readily and satisfactorily furnish the required material. (This has already been done for a large part of our outstanding war orders and is in progress, to some extent at least, for all of them.)

The next step, is, naturally, to get together all those items which pertain to each prospective equipment manufacturer, and in consultation with him see how total requirements are related to his manufacturing capacity. Obviously, this is a matter which goes beyond the Ordnance Department. Although the requirements of that department in the aggregate in time of war will be larger than those of any other government department, efficient team work requires that they be not given precedence over others but that all be properly related to the whole war program.

This brings us to the question of higher control. As far as the War Department is concerned, the National Defense Act as revised in 1920 provides in the Office of the Assistant Secretary of War an agency to control the activities of the various branches of the War Department as far as they affect industry. That office bears to the industrial activities of the War Department the same relation that the General Staff does to the military. It is organized for war very much along the lines of the War Industries Board. Coördination between the requirements of the several branches is secured by means of "Commodity Committees."

For instance, the Machine Tool Committee will probably be composed of representatives of the Ordnance Department, the Quartermaster Corps, the Air Service, the Corps of Engineers, and the Chemical Warfare Service, the chairman coming from the Ordnance Department. All committees function under the Assistant Secretary of War, the chairmen reporting directly to his office. In time of war, these committees would be strengthened by the addition of suitable experts from civil life who would come in either as temporary officers or as civilian employees. In time of peace, the duty of the committees is to carry on a continuous study of their respective commodities both from the standpoints of requirements and of available supplies.

Coördination between the industrial efforts of the War and Navy Departments is also of very great importance. The agency for securing this is the Army and Navy Munitions Board instituted by joint agreement between the respective Secretaries in 1922. This Board is composed of the Assistant Secretary of War and the Assistant Secretary of the Navy. A number of sub-committees of the Army and Navy Munitions Board is charged with carrying on the details of the work. Among these is the Power Plant, Machinery and Machine Tools Committee. The Army representatives on this board are the Chief of Ordnance, the Quartermaster General and the Chief of Engineers. The Navy Department has corresponding representatives. The recommendations of this committee, when approved by the respective Assistant Secretaries, become the joint decisions of the two Departments.

In this discussion it is only possible to give a very brief and sketchy outline of the machinery proposed for handling the machine tool and, in fact, the general shop equipment problem created by the necessity of furnishing our troops promptly and adequately with the necessary material of war. This is not the whole structure, although it is the major part of it. Whatever additional organization is set up must necessarily be in agreement with the wishes of the President of the United States at the time of the emergency. Its chief personnel must have his entire confidence and will be selected by him with the same care as the members of the Cabinet.

Frankford Arsenal Ammunition in Switzerland

Notes on the 1925 International Matches

By

Maj. J. S. Hatcher, Ord. Dept. U. S. A.

Adjutant U. S. International Rifle Team

STRAIGHT shooting and expert marksmanship have been a tradition with the Swiss Nation since the days of William Tell. Among all the rifle shots of Europe since marksmanship became an art, the Swiss have excelled.

For a number of years past there have been held an annual series of International Rifle Matches under the auspices of the International Shooting Union. For many years the Swiss have regularly won this match, until their supremacy in this field came to be taken as a matter of course.

A feeling of security was fully established when in 1913 the International Matches were held at Camp Perry, Ohio, and the Swiss Team which came over, won the championship. However, this feeling of security and superiority received a rude shock when the United States sent a team abroad after the war and won the International Matches for the first time in history. The result was that the Swiss at once began to imitate our team in the matter of equipment, especially as regards wind gauge sights, etc. Nevertheless the succeeding year the American Team again won.

In 1923 the International Matches were held at Camp Perry, but owing to the expense of sending a team to America, none of the European nations participated. However, the Swiss utilized the intervening year to greatly perfect their equipment, and appeared at the International Matches at Rheims, France, in 1924, determined to win or know why. Unfortunately for them, the Americans had also been at work improving their equipment, and the ammunition carried by the American Team was better than ever before.

The result was that the Americans again won the matches with a score just one hundred points higher than the Swiss.

In this type of shooting there is no restriction as to the rifle or ammunition used except that of safety. Telescopic sights cannot be used, but otherwise anything goes.

In the past two or three years in the United States there has gradually become developed an arm known as the "free rifle," with which these matches have been shot. This gun is a heavy-barreled Springfield, fitted with set triggers and a palm rest. The sights used are special target peep sights with very fine adjustments for elevation and windage.

The uniform success of the American Team for the past three years has excited the greatest of comment among European military and shooting circles. It has repeatedly been stated by European competitors that the reason the Americans win is because of the excellent backing given American marksmanship at large by the Army Ordnance Department.

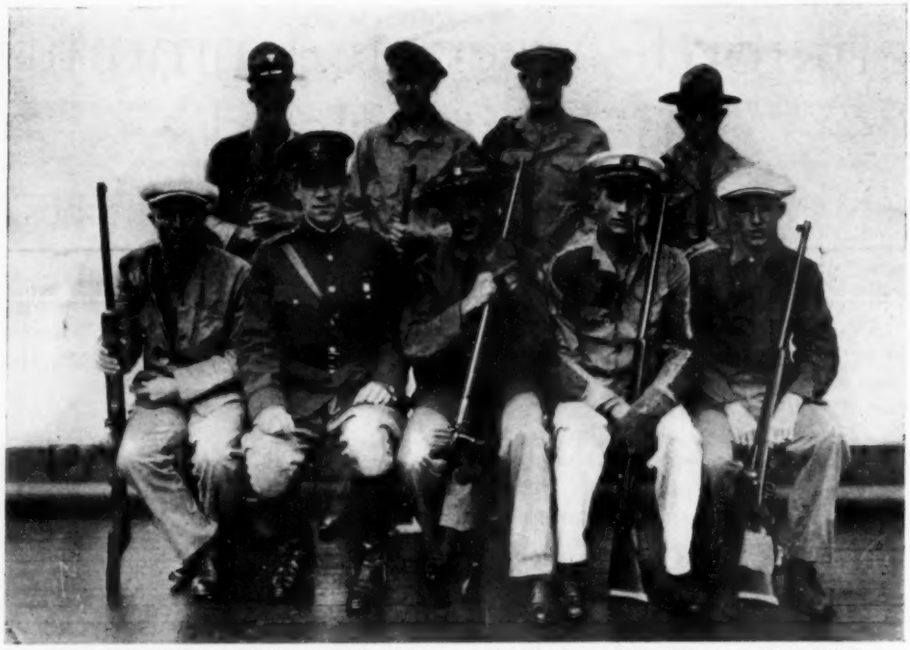
Partly as a result of these matches the American rifles and ammunition have gotten a reputation throughout Europe of being the best in the World, and the impression thus gained has reacted very favorably to American trade.

This year for the first time, the team met the Swiss marksmen on their own home ground. The matches were held in the Canton of St. Gall, near Lake Constance. St. Gall is the center of Swiss shooting, and is the home of former World's champions, among whom may be named Widmer, a famous gunsmith who is still in business in St. Gall, and Steheli, seven times World's champion, who is also a resident of St. Gall at the present time.

The attitude of the people of Switzerland towards the American Team was a revelation to all who witnessed it. These people take the most intense interest in shooting, not only among what would be regarded as shooting circles in this country, but in every class of society, including women and children. The shooting matches are to them what the World's Series in baseball is to us. Consequently the most intense interest in our team was manifested on every side and by every class of citizen. In hotels, on trains, and everywhere that we went the rifles in particular came in for the most marked scrutiny.

The attitude of the people was friendly and courteous to the extreme. The Swiss furnished the American Team with a rifle range exclusively for its own use for practice, and as soon as the people in the neighborhood heard that the American Team was to practice there, the range was crowded with spectators, mostly women and children. Every shot that was fired was carefully noted by many of the "fans," and it was a common sight to see small boys of ten or eleven years old, writing down the complete practice scores shot by shot. Before the day's practice was over it was known in all the surrounding towns just how each man on the team was going in practice.

From the location of the range in the mountains, it was possible to look down on five other rifle ranges each belonging to a small village. All of them were within a radius of four or five miles.



U. S. International National Rifle Team on Board U. S. Line Steamer "Republic"

Front row (left to right): Sergeant Coulter, U. S. M. C.; Major Hatcher, Ord. Dept.; Major Boles, F. A. (team captain); Ensign Morgan, U. S. N.; Staff Sergeant Meeds, D. C. N. G. Back row: Lieutenant Phillips, U. S. Eng.; Lieutenant Dodson, P. N. G.; Sergeant Joerger, U. S. Inf.; and Sergeant Fisher, U. S. M. C.

U. S. Team at International Matches

Major Boles shooting, Major Hatcher at telescope coaching.

The shooting stand and club house viewed from a point near the targets.

The targets viewed from firing point. The targets are 328 yards away.

The International Matches were held in connection with the Cantonal Matches of St. Gall, which lasted a week before the International Matches started. A Canton is no bigger than the average county in the American states, and yet in these Cantonal Matches there were from five to eight thousand shooters attending every day, and from twenty to thirty-five thousand shots were fired each day of the matches.

In order to support their rifle team financially, the Swiss got out stamps, somewhat on the order of our own Red Cross Stamps, and they were sold throughout the country for a small sum; the resulting funds being used for equipping the team.

The moral support given by the Swiss to their shooters is almost past belief. On the opening day of the big matches a parade was held which was really a wonderful treat to see. All of the shooting societies participated, and there were groups in costume representing the uniform of Swiss soldiers of various periods since the earliest history of the Helvetians.

After the parade there was a mass-meeting in Cathedral Square, with speeches and patriotic songs by a male chorus.

That night an opening banquet was held at the Rifle Range, with singing, gymnastic exhibitions, etc. A stage was specially built at one end of the banquet hall for this purpose, and there were Swiss village scenes in the native costumes, yodeling, folk dances, etc. Finally there was a series of magnificent tableaux showing the different famous battles in Swiss history.

A similar entertainment was had every night during the matches. During the daytime the enclosure containing the Rifle Range was fenced off into a kind of fair, with various amusement booths, etc., and an admission fee of one dollar was charged to the public at large to get into the grounds, although of course our team had complimentary passes to everything.

Before the main event of the International Matches there was an illumination which was a remarkable example of coördination on the part of the population of a large city. St. Gall is built on two hills, and at nine o'clock on the night in question a cannon was fired. At this signal every house on the North hill of the city lit a pyrotechnic device of colored fire. For a period of six minutes the entire town was outlined in a brilliant red light. At the end of this time the light changed to green. Then after a while it changed back to red again.

Each householder in the Northern half of the city of St. Gall purchased one of these red and green light fireworks for the celebration, at a cost of about $1.50, and the project was carried through with the utmost precision.

Upon the completion of this illumination another cannon shot was fired, and from every house in the Southern half of the town a rocket was sent up.

On the day of the match the President of Switzerland, accompanied by most of the high Government officials, attended the match in person. He appeared greatly interested in the equipment of the American Team, and between scores came over to where our team was and talked for sometime about the matches. The President himself is an enthusiastic shot, and frequently fires in the matches. He has a large collection of medals and trophies to testify to his skill in marksmanship.

In these matches the Swiss used a rifle with Martini action, which is very much faster than our own Springfield, and they used an improved set trigger, which was far better than the one with which our team was equipped. The Swiss Team was also supplied with super-accurate Swiss service ammunition manufactured specially for these matches by the Swiss Government.

The Swiss Matches are all fired at a range of three hundred meters, on a target which has a 10-ring, 4 centimeters, or 3.93 inches in diameter.

The main event is the International Team Match, shot by a team of five men, each man firing forty shots standing, forty kneeling, and forty prone. The highest possible score is 1,200 per man, or 6,000 per team.

This year the Swiss were on their own home ground and were keyed up to the highest point of enthusiasm, and on the big day every man came across with his own best score, and the resulting combination shattered all records.

In the Team Match the Swiss Team shot a score of 5,386, which was 85 points ahead of the previous World's Record, leaving the United States Team in second place with 5,255.

In the standing and kneeling positions the difficulties of holding the gun steady are so great that even moderately good ammunition shoots better than the best rifleman can hold, and the errors of the shooter mask the performance of the ammunition.

In the prone position this is not so, for such an extremely steady position can be taken by the rifleman that small differences in ammunition will show up.

The remarkable grouping ability of the Frankford Arsenal International Match Ammunition was demonstrated in a striking manner by Lloyd T. Meeds, of Washington. During the entire practice, as well as during the matches, Mr. Meeds was holding like a rock in the prone position, and accordingly this gave the ammunition a chance to show what it could do.

One of the most important individual matches is the Unlimited Re-entry Match, in which each member is allowed to fire one hundred targets of four shots each. The best ten targets turned in by each member are counted toward the record. A perfect target, or possible, means that all of the shots must go into a circle of 3.9 inches in diameter, at a distance of 328 yards. When you add the inevitable errors of the rifleman, this means that the ammunition must practically shoot into the same hole.

When Mr. Beauchamp, the English representative at the matches, was speaking of the Re-entry Match, he said "A possible will want a bit of making."

Nevertheless Mr. Meeds made seven possible targets, and the remaining three targets of his best ten were only one point each below a possible. This means that out of his ten best targets all but three shots went into the 3.9-inch circle at 328 yards, and the remaining three shots were barely over the line.

Such a remarkable score has never before been approached in this match, and it would not have been possible without ammunition of superlative accuracy.

Forensic Ballistics

By

Maj. C. H. Goddard, Ord. Res.

ORDNANCE engineers and arms enthusiasts know from sad experience how difficult it often is to secure a simple bit of information covering the rifling specifications of some foreign, or even domestic, pistol or revolver. In the case of American-made products, this is not ordinarily due to reticence on the part of the makers, but simply to the fact that they haven't the information themselves. Current models they can tell you about—ah, yes, but the obsolete ones—well, who wants to know about those anyway? This is not surprising in the case of companies that have passed through two or three changes of ownership, or whose records have been wiped out by fires, but, alas, it is not confined to these alone. Some of our oldest and largest makers with unbroken ownership records and no fires, earthquakes, or tornadoes to their credit, have very little data concerning their earlier models.

A comprehensive collection of such data probably never would have been gathered and made available to the world but for a murder trial which took place in a county in the western part of New York State in 1915. The relation between murder trials and shop standards of gun factories may seem a rather distant one, but it is not necessarily so. In this particular instance a man was condemned to death for a murderous assault with a revolver, conviction being obtained upon the basis of "expert testimony" for the State so preposterous as to arouse the very keen interest of one Charles E. Waite, of New York City, a life-long criminal investigator. He was later commissioned by the Governor of New York to make a special study of the case. As a result the true murderers were eventually apprehended, a confession secured, and the condemned man pardoned.

Mr. Waite, who up to that time had known nothing about firearms, and cared less, was worried. If innocent men could be sent to their deaths on the opinions of ignorant or unscrupulous firearms "experts," would it not be possible to secure facts and figures which would answer questions of ordnance and ballistics in a definite, scientific manner, and throw "opinions" into the discard? At least he would try to find out.

So there began an effort to accumulate firearms data, with especial reference to bore and rifling specifications, covering every make and model of pistol and revolver, which would be as complete as it was humanly possible to make them. All the American makers were visited. They were very kind, and glad to offer what they had. But they didn't have enough! Not only were specifications covering old models missing, but in some instances they could not even name the dates when changes in those of current ones had taken place. A change had been made, and about such and such a year, but the month and day—now you were getting down to too fine a point. The number of the first piece in which the change was embodied was of course even more important, and even more often lacking. Lest the significance of securing such numbers be not understood, a theoretical instance of its application may prove useful. The ABC revolver company makes a .38 caliber model, rate of pitch, one turn in 17″. Prior to June 10, 1915, the rate was one turn in 22″. The first gun of the new series was No. 25,747.

A man is murdered, and a suspect jailed. He owns a .38 ABC revolver, and examination of it shows that it was recently fired. The bullet from the body bears all the earmarks of having passed through the barrel of an ABC. Its rate of pitch (method of determining this is described later) measures out at 22″. The suspect's gun is No. 40,262. Having been made since the date when the pitch was changed to 17″, it plainly could not have fired the fatal bullet, and we are saved the trouble of firing test loads through it and attempting to match them against the one which caused death.

Began then a series of visits to retired shop foremen, graybeards whose memories and experience ran back to first models. And in almost every instance, these worthies had preserved ancient notebooks containing just the dates, dimensions, and serial numbers desired!

Finally a point was reached where Mr. Waite felt that he was in a position to supply positive information in any legal or other dispute covering assault with pistol or revolver where a question of bullet or barrel diameter, rate of pitch, etc., was at stake. Alas, he was due for a rude awakening. A survey of guns caught in the police net in New York City over a period of a year showed between 80 and 90 per cent to be of for-

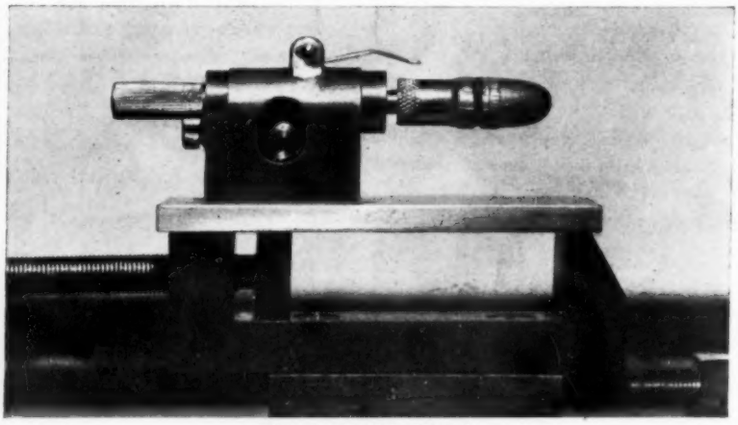


Fig. 1. Bullet Mount

The projectile is held in place by a layer of wax on its base obviating danger of scratching as when held mechanically.

eign make. His American specifications were all right so far as they went, but they covered only a fraction, a very small fraction, of the field. Nothing daunted, he armed himself with letters from the Department of Commerce, War Department (Military Intelligence), and New York Police Department, and took steamer overseas. There, accompanied by a friend, an army officer, who, versed in ballistics and a fluent linguist, acted as interpreter, he visited the various arms centers on the Continent. Makers everywhere presented him with copies of their specifications, and he returned with a trunkfull of statistics, catalogs, blueprints, and specimens of arms and ammunition.

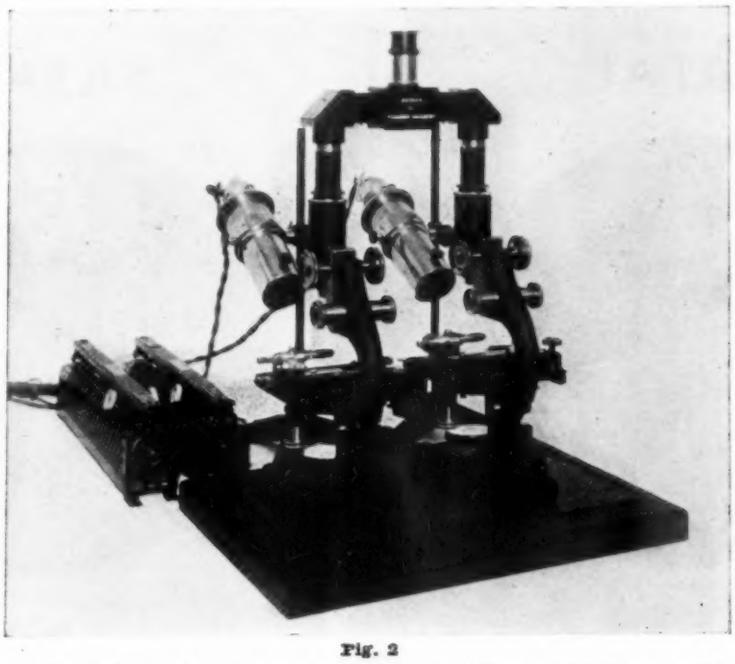


Fig. 2

Comparison microscopes showing set-up of the instruments and the connecting cross arm which fuses the two images in its central eyepiece.

His data digested, classified, and indexed, he was now prepared to say to any honest seeker after facts, "Give me a bullet from an unknown pistol, and I will tell you the make, model, and caliber of the arm that fired it." And this he can do, in the great majority of cases. The method is simple enough. An "unknown" bullet is presented. The micrometer caliper shows its overall diameter (groove diameter of pistol) to be .3000″. It bears the imprint of six lands and grooves, right twist. Groove depth by Ames gauge (average of six determinations) is .0019″, leaving a groove diameter (bore diameter of pistol) of .2962″. Groove width (land width of pistol) as determined (average of six estimations) under a microscope equipped with a Filar micrometer eyepiece, a lens system so constructed that one graduation interval on the scale in the eyepiece equals ten thousandths of an inch on the bullet, and a fine adjustment screw which further subdivides each of these graduations into a hundred parts, is .0453″. Rate of pitch, determined by simple trigonometry after reading the angle between one edge of a groove and the axis (edge)[1] of bullet (using the Filar eyepiece with a pointer attached, in a miscroscope with protractor mounted on draw tube) works out at approximately 9.5″. The bullet is metal jacketed and weighs seventy-four grains. Evidently it was made to be fired from a .32 automatic pistol. Inquiry develops the fact that several .32 automatic empties were found near where the crime was committed. The burden of proof is therefore against its having been fired from a revolver, for criminals using revolvers ordinarily do not throw away their empties near the scenes of their activities. (The shells, if available, would pretty certainly tell the story as between revolver or automatic.) It is important to know, if possible, whether a revolver or automatic was used, as this naturally limits materially the ground to be searched.[2]

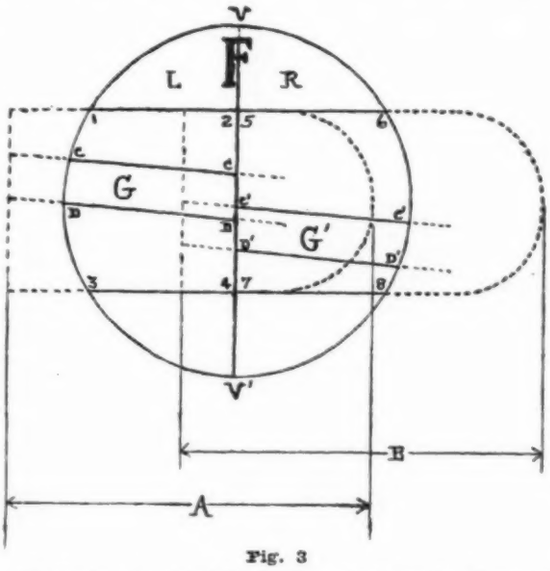


Fig. 3

Diagram of unmatched grooves as shown in the combined image (see text).

Consulting the records of American automatic pistols of .32 caliber, we find five—Colt, Savage, Infallible, H. & R., and Remington. The first is at once eliminated on the direction of its pitch—left. Savage follows to the discard because its groove depth is twice that of the unknown, and its twist slower. Infallible bats out on a slower rate of pitch, while H. & R. also shows a slower twist and a deeper groove, and Remington fails to qualify because of an odd number of lands and grooves.

American arms eliminated, we turn to the foreign products. By excluding first all with a left twist, then all with more or less than six grooves, then those with groove depth over .002″ and rates of pitch over 10″, we narrow the search down to less than half a dozen makes. The groove width (land width of pistol) gives the finishing touch. No make of a 6 groove, right twist, .32 caliber automatic pistol with a rate of pitch between nine and ten inches and a groove depth in the vicinity of .002 uses a land width of approximately .045 save Nicholas Pieper, of Liege, Belgium! And so the report goes forth.

---

[1]The edge of the cylindrical portion of a bullet being parallel to its axis, makes the same angle with the groove as does the axis.

[2]It is not generally known that large numbers of foreign-made revolvers are chambered for the .25 and .32 automatic pistol cartridges.

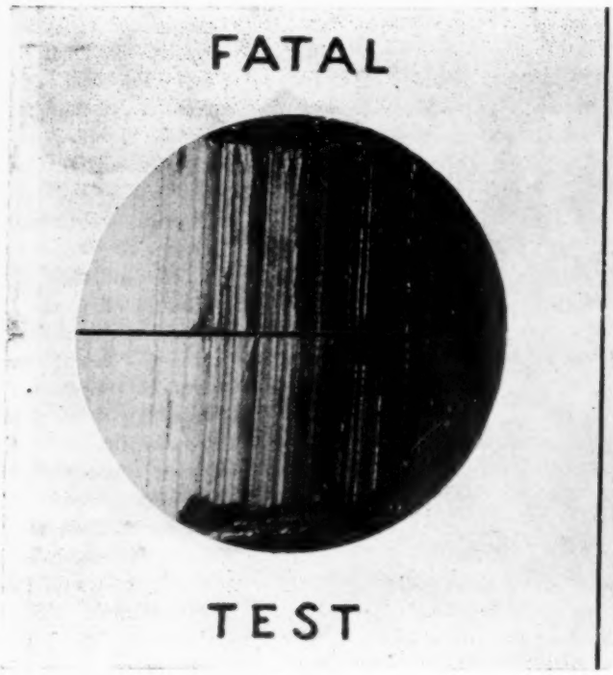


Fig. 4

A perfect match (between lands). Linear striations in the two halves of the field blend perfectly at the midline.

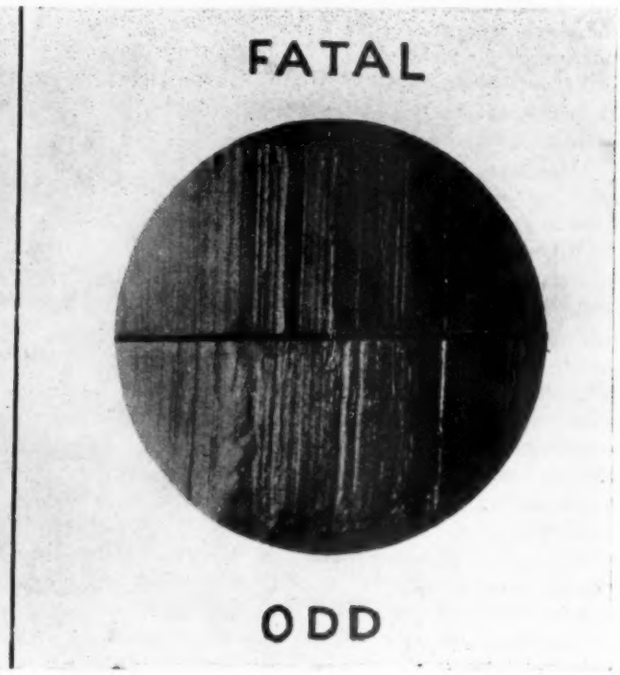


Fig. 5

No match. Linear striations in the two halves of the field end abruptly at the midline.

It can readily be seen that, in order to make such a determination unfailingly accurate, knowledge of the shop standards involved in the manufacture of *every* pistol and revolver now being made or ever made in the past, would be required. While this is manifestly beyond the power of human accomplishment, Mr. Waite's files do contain records of between 1,300 and 1,400 different models—by no means an unimposing array. Furthermore, he and his associates[3] are constantly adding to these through the examination and measurement of obsolete specimens in the hands of collectors, through correspondence with makers concerning their new models, and through the acquisition of specimen arms and of catalogs and data concerning makers now out of business.

As a single example, the writer recently spent some weeks in the U. S. Patent Office at Washington in the collection of information covering over 1,000 patents on pistols and revolvers. We now have a record of practically every such patent issued from 1833, before Samuel Colt came upon the scene, to 1925. Each entry includes the date and number of patent, name and residence of patentee, and a short resumé of the specifications. Of what use pray? Because we not infrequently come upon an arm put out by a well-known house under contract for some wholesaler. The maker's name is omitted, and a trade name used. This gets us nowhere, unless we already have record of it (the trade name). But the gun will bear the same patent dates as does the maker's regular product. Looking these up in the records gives us the name of the patentee (never have more than two, or at most, three, revolver patents been issued on the same day, and these have always applied to arms so different that confusion would not be possible). Given the patentee, it is a short step to the maker. Ordinarily we have his shop standards already recorded, and they naturally apply to his "trade" guns as well as to his regular products. Thus we are saved the trouble of working these out for the arm in question.

The determination of the type of weapon projecting an unknown bullet is, as we have seen, based upon sound reasoning and scientific principles, but nevertheless subject to very definite limitations. A very important one of these, not heretofore discussed, is the condition of the bullet when recovered. Lead bullets are very prone to suffer both deformation and loss of substance when passing through a human body. If the deformation is excessive, it becomes manifestly impossible to reconstruct from their measurements those of the barrels which projected them. Jacketed bullets, as commonly used in automatic pistols, usually escape deformation except when striking bone, and even then their contours are often but slightly modified. But any degree of deformation, no matter how slight, naturally complicates matters.

When, on the other hand, we are given a bullet and an arm, and asked to determine whether this particular arm fired this particular bullet, the problem becomes much simpler. Indeed the bullet must be battered almost entirely out of shape to make it insoluble. Quick measurements of the bullet with micrometer caliper and of the gun muzzle with a plug gage will determine at once whether or not the former *could* have issued from the latter. (If, in the absence of deformation, bullet diameter is materially larger or smaller than that of barrel, manifestly it could not have passed through that barrel.) Again, if the grooves in bullet and barrel vary in number, direction of pitch, or so materially in width that the difference is visible to the naked eye—of course the game is off. But if the measurements tally closely enough, and the other elements are in

[3]Mr. Waite and three others interested in his work (one of them the writer) have recently joined to form the "Bureau of Forensic Ballistics," 4 East 28th St., N. Y. City, for the purpose of supplying exact ballistic information in legal cases.

accord, the next thing is to fire a series of test bullets through the gun in question, recovering them from a bag of cotton waste. (They come out quite perfect.) The fatal bullet and one of the test bullets are now mounted in holders which permit their free revolution horizontally about their long axes (Fig. 1), and locked in mechanical stages upon two microscopes which are fixed, about six inches apart, upon a single base. A hollow horizontal cross-arm, circular in section, bridges the distance between the microscopes, over the eyepieces of which its ends fit snugly (Fig. 2). An arrangement of prisms within it throws the image of the bullet beneath the right hand scope into the right half of the field of the single eyepiece which projects upward from its center. The image of the other bullet occupies the left half of the field. By manouvering the mechanical stages, the two images may be made to coalesce. We now see what appears to be a single bullet with a line drawn vertically across its center, perpendicular to its long axis. Unless we have undertaken to match the grooves of the two bullets, however, one to another, the combined image in the eyepiece will show two sets, each ending, or starting as the case may be, at the vertical dividing line. This condition is demonstrated in Fig. 3. Here we have the field F divided by the vertical median line V-V′ into two equal parts—R and L. A portion of the image A reflected from the bullet under the left hand miscroscope, is shown in field L, its area being outlined by the numbers 1, 2, 3, 4. A similar portion of the image B from the bullet under the right hand miscroscope appears in field R, outlined by numbers 5, 6, 7, 8. On the surface of each bullet, one groove appears (G and G′). In each case, it ends abruptly at the vertical dividing line. To make the two merge into one, we hold bullet A fixed, and revolve bullet B in its mount until the lines C′C′ and D′D′ have moved upward sufficiently to meet with and become apparent prolongations of CC and DD.

Seen under the miscroscope, each groove shows, running in its trough parallel to its edges, a number of fine lines, imprinted in it by minute irregularities in the surface of the land over which it passed. From half a dozen to a score or more may be seen in practically every groove examined. Their depth and distribution naturally vary from groove to groove, *but are always the same for corresponding or we might say, homologous, grooves upon bullets that have passed through the same barrel.* In other words, each barrel leaves upon every bullet that passes through it, a fingerprint that is peculiar to it and to it alone—just as characteristic, and just as useful for purposes of identification, as the print left by the human finger. For the microscopic irregularities upon the lands of no two pistols can ever be exactly alike, any more than are the markings on two fingertips.

Armed with this knowledge, we study the fine striations in the troughs of the grooves G and G′. If they, as well as the edges of the grooves, merge into one another as the vertical dividing line is reached, we need look no farther: fatal and test bullets both issued from the same barrel. But if each set ends abruptly at the mid-line, we still have several other grooves to try before we announce a negative finding. Holding bullet A still fixed, we revolve B until another groove come sinto view. This we match against groove G and study carefully. We continue to do this until all the grooves of B have been matched against groove G. If the bullets have both issued from the same arm, some one of the grooves of bullet B *must* match perfectly, in all its microscopic details, with groove G. If they are from different arms (even though of the same make, model, and caliber, and perhaps rifled consecutively, a few minutes apart) such matching *cannot occur.*

Needless to say, if one groove of bullet B is found to match groove G of bullet A, we proceed to revolve both bullets simultaneously, bringing successive pairs of lands and grooves before the eye, the result being a perfect series of matches all around the circumferences of both bullets. Fig. 4 shows an instance of such matching (between lands) and Fig. 5 of failure to effect a match.

The beauty of the system lies in the fact that a mortal bullet may be terribly battered, yet if a single section of a single groove, but a fraction of an inch long, remain unmutilated, the microscopic striations in it may be compared with those in the corresponding area of the corresponding grooves on a test bullet just as accurately as though the entire fatal bullet had been without deformation.

This article has dealt at some length with descriptions of methods which, while interesting to criminologists, have but slight connection with Army Ordnance affairs. This seemed necessary, however, in order to explain why a group of men should have set about to collect the data described in the first few paragraphs. Now that this data is accumulated, there seems no reason why it should not be made available to those who have legitimate uses for it. Mr. Waite has therefore acceded to the suggestion of the writer that we put it at the disposal of the Army Ordnance Association. It is our hope that we may from time to time be able to save members of that distinguished company some of the tedious and costly inquiries which characterized the first years of Mr. Waite's struggle to establish a scientific system for the identification of projectiles recovered after firing.

The Behavior Under Stress of the Iron Crystals in Steel

Part II

By

H. H. Lester and R. H. Aborn

Experimental Results

MECHANICAL TESTS

ON account of the voluminous data taken, typical rather than complete results are given in the tables that follow, complete results are represented in the crystal deformation curves, and typical stress-strain curves of the crystalline aggregates are plotted along side of the crystal deformation curves for purposes of comparison.

Tables I, II, and III show typical stress-strain results for the three materials studied.

TABLE I

Stress-Strain Tests on Blued Shim Stock Material

Test No.	Gage Length Inches	Width Inches	Area Square Inches	Method	Modulus of Elasticity lbs./in.²	Proportional Limit lbs./in.²	Yield lbs./in.²	% Permanent Extension	Time Interval Between Tests	Tensile Strength lbs./in.²
R-4-2.....	12.63	0.25	.000791	Optical Micrometer	24.0 x 10^6	79,100	93,600			
R-4-3.....	11.28	0.120	.000372	"	26.3 x 10^6	75,000			57 days	
R-4-4.....	"	"	"	"	26.6 x 10^6	77,000	86,000	.02%	15 min.	
R-4-5.....	"	"	"	"	26.9 x 10^6	80,600	91,400	.04%	90 min.	
R-4-6.....	4.85	"	"	"		75,000	91,400	.09%	15 min.	
R-4-7.....	"	"	"	"	25.0 x 10^6	86,000	96,800	.17%	15 min.	
R-4-8.....	"	"	"	"	26.2 x 10^6	95,000	102,100		9 days	
R-4-9*.....	"	"	"	"	24.7 x 10^6		123,700		40 hrs.	
R-4-14.....	4.67	"	"	"	26.0 x 10^6	91,300	129,000		3 hrs.	
R-4-15.....	4.51	"	"	"			129,000		15 min.	
R-4-16.....	"	"	"	"	25.2 x 10^6	91,300	134,000			153,000

Average Modulus.....25.7 x 10^6

*Test R-4-9 was made after the specimen had stood one week subjected to a load of 102,000 lbs./in.².

TABLE II

Stress-Strain Tests on Low Carbon Steel Ribbon

Test No.	Gage Length Inches	Width Inches	Area Square Inches	Method	Modulus of Elasticity lbs./in.²	Proportional Limit lbs./in.²	Yield lbs./in.²	% Permanent Extension	Time Interval Between Tests	Tensile Strength lbs./in.²
WS-1-1.....	20.25	0.139	.000292	Optical Micrometer	29.0 x 10^6	54,800	89,000			
WS-1-2.....	"	"	"	"	28.0 x 10^6	65,100	92,500		45 hrs.	
WS-1-3.....	"	"	"	"	29.2 x 10^6	41,200			5 hrs.	
WS-1-4.....	"	"	"	"	29.0 x 10^6	55,000	85,600		19 hrs.	
WS-1-11.....	11.78	"	"	Micrometer Microscope	30.5 x 10^6	32,000	71,900		6 hrs.	85,600
WS-1-12.....	"	"	"	"	28.4 x 10^6	45,000	75,300		1 day	
WS-3-1.....	8.78	0.138	.000304	"	28.6 x 10^6	49,400	75,800	.03%		75,300
WS-3-2.....	"	"	"	"	28.0 x 10^6	52,700	79,000	.08%	1 day	
WS-3-3.....	"	"	"	"	29.0 x 10^6	47,000	79,000		3 days	
										79,000

Modulus by Optical Micrometer Method.....28.8 x 10^6 lbs./in.²
Modulus by Micrometer Microscope Method.....28.9 x 10^6 lbs./in.²

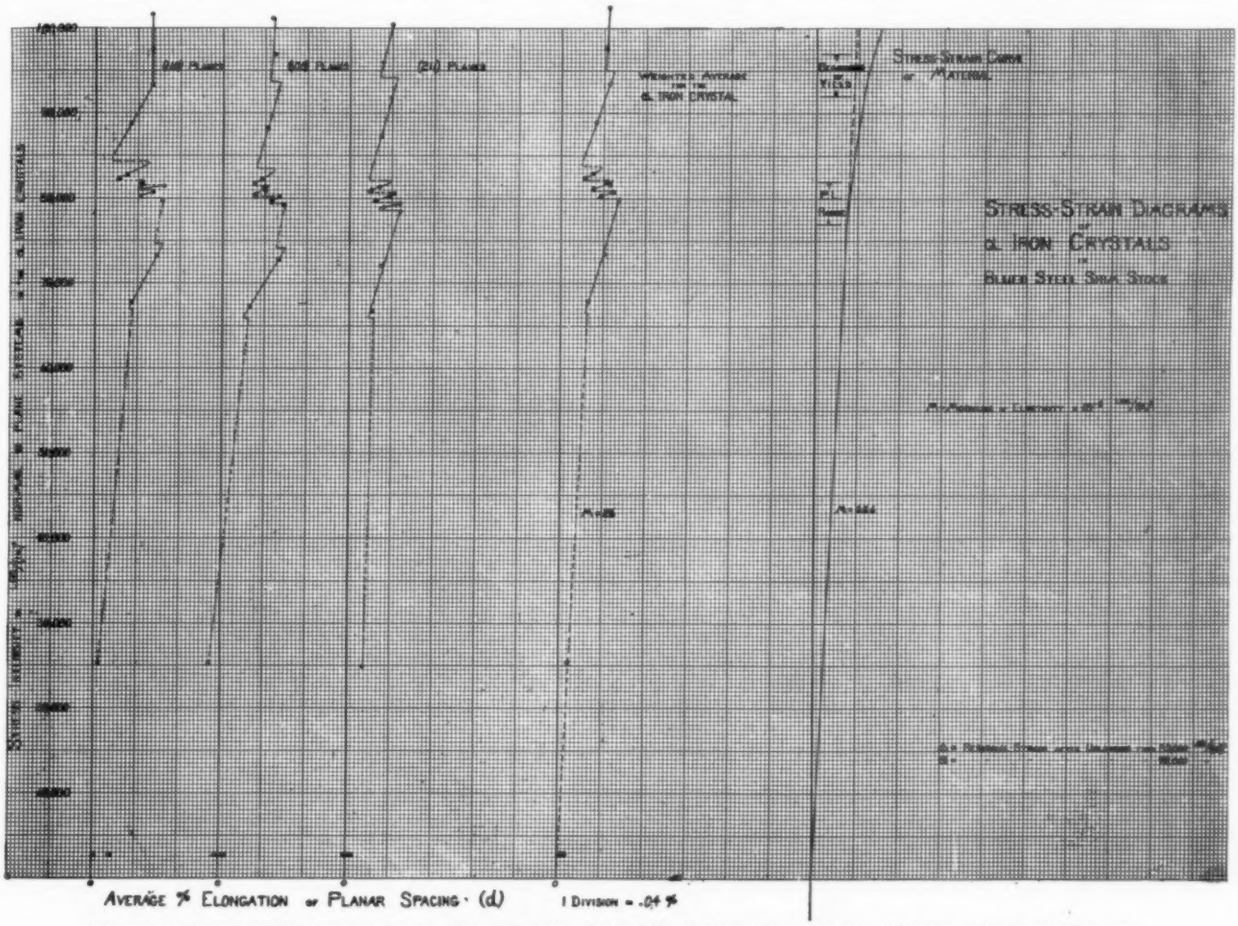


Fig. 13. Stress-strain Diagrams for the Crystals of the Blued Material and for the Crystalline Aggregate.

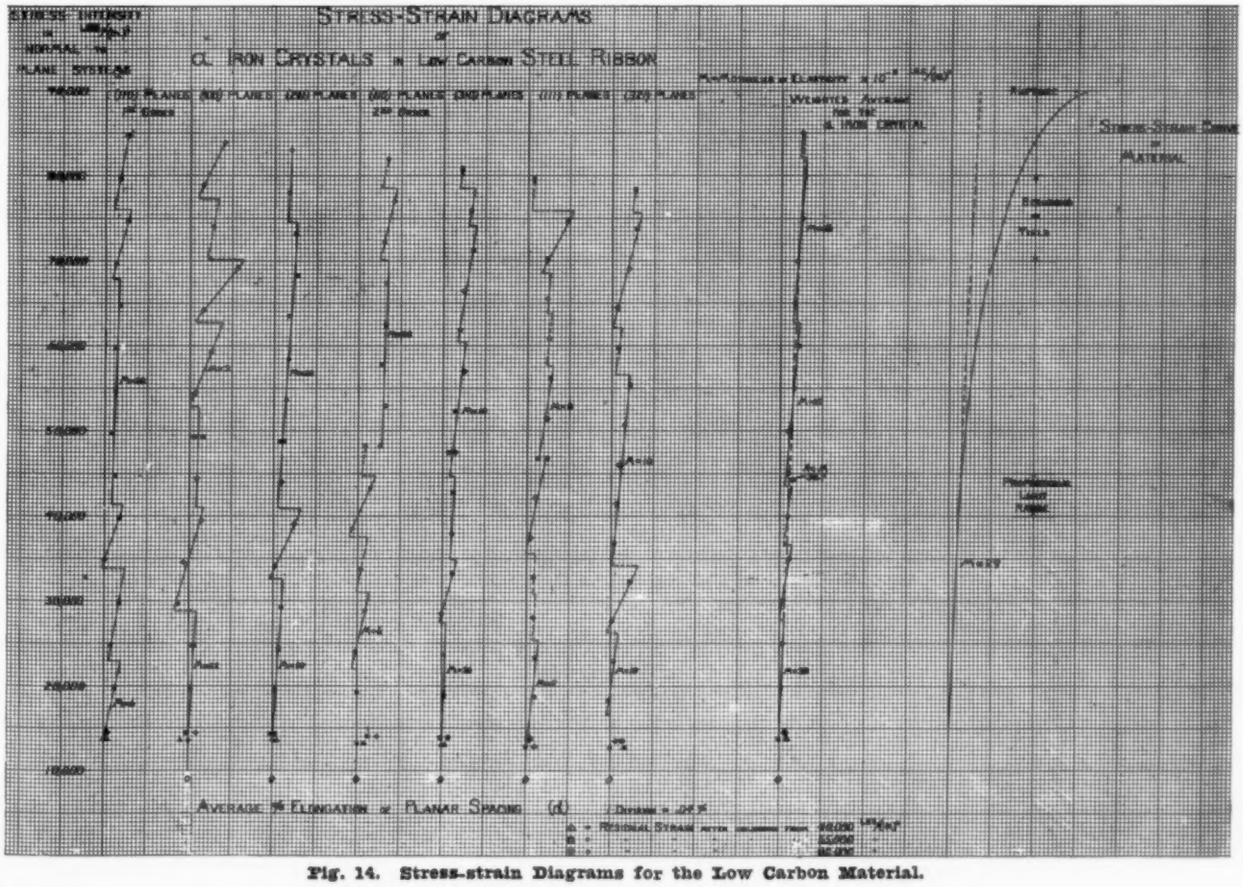


Fig. 14. Stress-strain Diagrams for the Low Carbon Material.

TABLE III

Stress-Strain Tests on Annealed Shim Stock Material

Test No.	Gage Length Inches	Width Inches	Area Square Inches	Method	Modulus of Elasticity lbs./in.²	Proportional Limit lbs./in.²	Yield lbs./in.²	% Permanent Extension	Time Interval Between Tests	Tensile Strength lbs./in.²
R-5-1.....	7.44	0.51	.00155	Optical Micrometer	20.2 x 10^6	35,000	48,700	0.66%	1 hr.	
R-5-2.....	"	"	"	"	20.2 x 10^6	44,000	54,600	1.36%		72,300
R-10-1.....	5.15	0.123	.000357	"	20.0 x 10^6	33,600	64,400	0.11%	1¼ hrs.	
R-10-2.....	"	"	"	"	20.1 x 10^6	40,000	70,000	0.18%		84,700
R-11-1.....	3.82	0.123	.000357	"	20.0 x 10^6	42,000	58,500	0.08%	6 hrs.	
R-11-2.....	"	"	"	"	22.2 x 10^6	53,200	64,400	0.12%	15 hrs.	
R-11-3.....	"	"	"	"	22.2 x 10^6	53,200	75,500	0.40%	1 hr.	
R-11-4.....	"	"	"	"	21.5 x 10^6	42,000	78,400			78,400
R-12-1.....	8.24	"	"	Micrometer Microscope	21.8 x 10^6	43,000	64,400			

Modulus by Optical Micrometer Method.....20.8 x 10^6 lbs./in.².
Modulus by Micrometer Microscope Method.....21.8 x 10^6 lbs./in.².

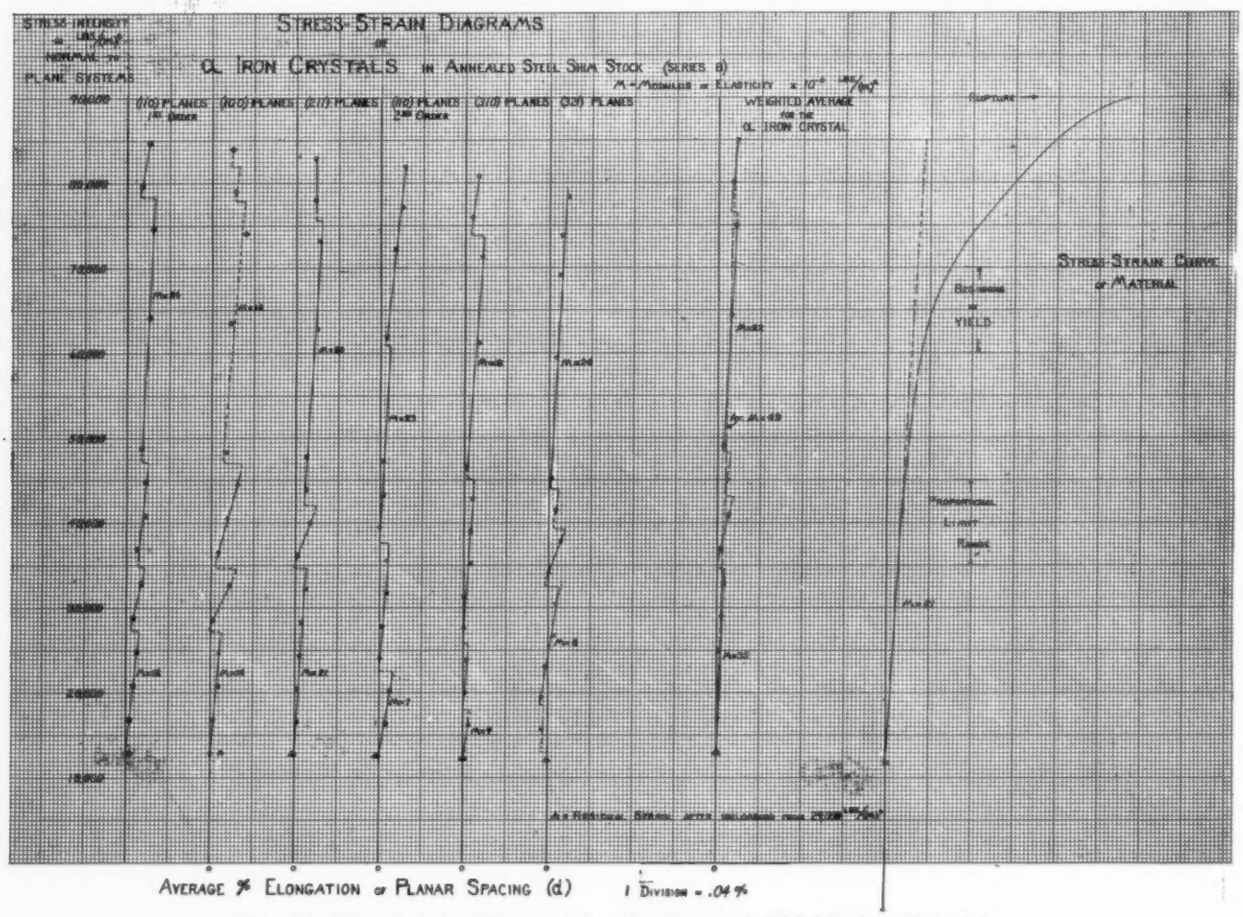


Fig. 15.—Stress-strain Diagrams for the Annealed High Carbon Material.

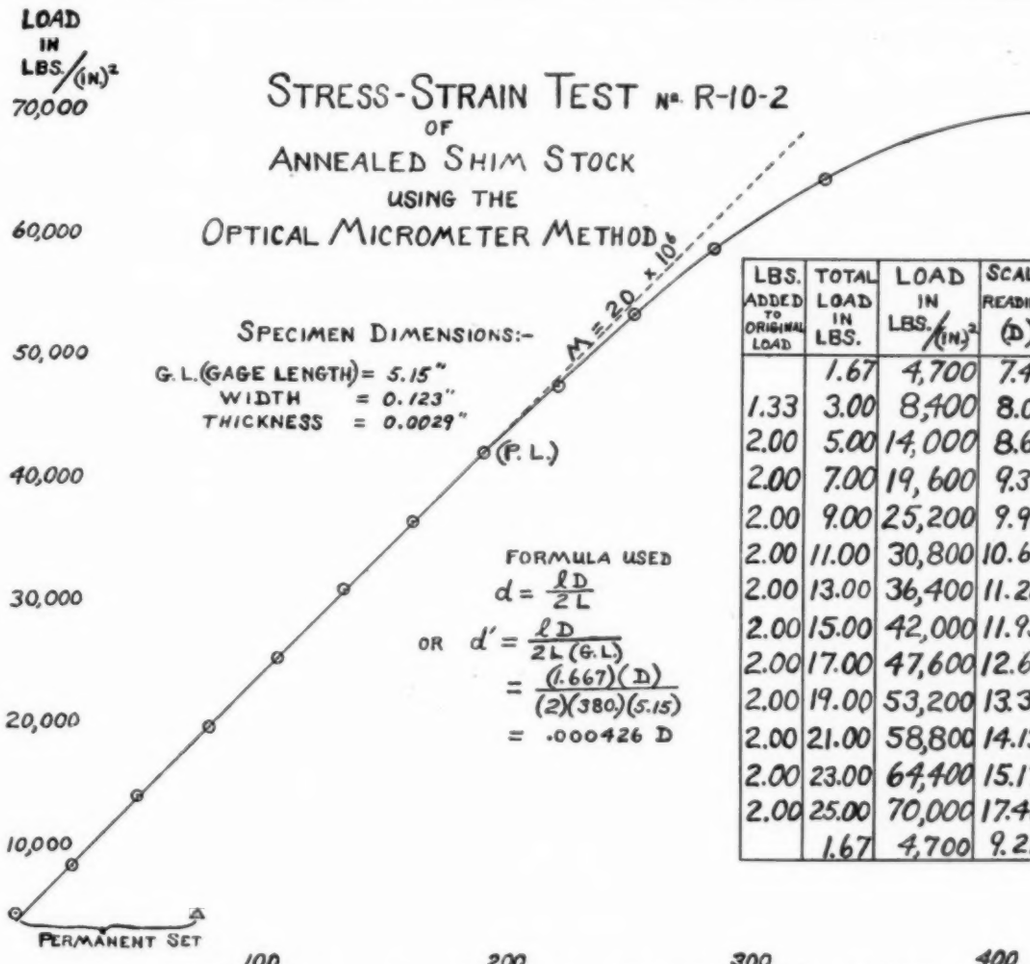
Results of Film Measurements

The diffraction equation,

$$\lambda = 2d \sin \Theta = 2d \sin \frac{180 \left(\frac{X}{2}\right)}{\Pi \quad R}$$

where R is the radius of the cassette, = 8 inches,
X is the arc value of 2Θ, expressed in inches,
and λ is the wave length of the x-radiation
= .70783 x 10^{-8} centimeters,

gives the values of d for the various values of Θ, except that for second order reflections, this value must be divided by 2. Data used for the calculations are shown in Table IV.



LBS. ADDED TO ORIGINAL LOAD	TOTAL LOAD IN LBS.	LOAD IN LBS./(IN.)²	SCALE READING (D)	ΔD	ELONGATION PER INCH (d')
	1.67	4,700	7.47	0.00	.000000
1.33	3.00	8,400	8.02	0.55	.000234
2.00	5.00	14,000	8.66	0.64	.000506
2.00	7.00	19,600	9.33	0.67	.000792
2.00	9.00	25,200	9.98	0.65	.001069
2.00	11.00	30,800	10.62	0.64	.001342
2.00	13.00	36,400	11.26	0.64	.001614
2.00	15.00	42,000	11.93	0.67	.001900
2.00	17.00	47,600	12.63	0.70	.002198
2.00	19.00	53,200	13.37	0.74	.002513
2.00	21.00	58,800	14.13	0.76	.002837
2.00	23.00	64,400	15.17	1.04	.003280
2.00	25.00	70,000	17.48	2.31	.004264
	1.67	4,700	9.21		.000741

Fig. 16.

TABLE IV

Data for X-Ray Study of *d* Iron Crystals

$\lambda = K\ \alpha_1$ line of Mo = 0.7078 x 10⁻⁸ cm. a = 2.861 x 10⁻⁸ cm. r = 8.00 inches.

Plane Systems in Order of Occurrence on Films	PLANAR SPACING (d)			X in Inches		cos (° — 5°)	sin (° — 5°)
	Expressed in Terms of the Cube Edge (a)	Expressed in Å $1Å = 10^{-8}$ cm.	Expressed in Inches				
(110) 1st order	$\frac{a\sqrt{2}}{2}$	2.023	7.965 x 10⁻⁹	2.812	10.1°	0.9960	0.0889
(100)	$\frac{a}{2}$	1.431	5.634 x 10⁻⁹	3.999	14.4°	0.9866	0.1633
(211)	$\frac{a\sqrt{6}}{6}$	1.168	4.598 x 10⁻⁹	4.926	17.7°	0.9755	0.2198
(110) 2nd order	$\frac{a\sqrt{2}}{4}$	1.012	3.984 x 10⁻⁹	5.716	20.6°	0.9632	0.2689
(310)	$\frac{a\sqrt{10}}{10}$	0.9046	3.561 x 10⁻⁹	6.431	23.2°	0.9500	0.3123
(111)	$\frac{a\sqrt{3}}{6}$	0.8260	3.252 x 10⁻⁹	7.085	25.5°	0.9367	0.3502
(321)	$\frac{a\sqrt{14}}{14}$	0.764	3.011 x 10⁻⁹	7.699	27.8°	0.9219	0.3875

Table V gives a set of typical film readings, including the check readings and the percentage deviation from the mean of the two sets which was taken as a measure of the accuracy. It should be remembered that the magnitudes involved in the deformations are very small and an error of 100% would in most cases be less than .1% of an atom diameter. The calculation of the accuracy for a number of films is shown in Table VI.

TABLE V

Film A-79—Measurements Recorded in Inches

Plane System	ORIGINAL MEASUREMENTS					CHECK MEASUREMENTS, 3 Months Later					Average Center Difference	Average Deviation	Limit of Accuracy Within
	Tension Side		Non-Tension Side		Center Difference	Tension Side		Non-Tension Side		Center Difference			
	Left Edge	Right Edge	Left Edge	Right Edge		Left Edge	Right Edge	Left Edge	Right Edge				
(110) 1st order	2.893	2.918	2.895	2.920	+.0010	2.829	2.847	2.830	2.848	+.0020	+.0015	+.001	50%
	2.893	2.921	2.892	2.920		2.829	2.846	2.830	2.850				
	2.893	2.920	2.895	2.920		2.828	2.848	2.830	2.851				
	2.894	2.918	2.892	2.921		2.828	2.846	2.831	2.849				
	2.891	2.918	2.894	2.920		2.828	2.846	2.829	2.848				
	2.893	2.918	2.894	2.919			2.847		2.849				
	2.893	2.922	2.895	2.918			2.848						
	2.894	2.919	2.893	2.921									
	2.893	2.921	2.894	2.918									
	2.893	2.918	2.894	2.919									
Av.	2.893	2.919	2.894	2.920		2.828	2.847	2.830	2.849				
(100)	4.079	4.096	4.079	4.101	+.0020	4.011	4.028	4.014	4.033	+.0030	+.0030	+.001	33%
	4.079	4.093	4.077	4.102		4.010	4.030	4.011	4.032				
	4.075	4.098	4.077	4.101		4.011	4.026	4.011	4.034				
	4.076	4.096	4.079	4.098		4.010	4.030	4.013	4.033				
	4.083	4.095	4.077	4.103		4.011	4.030	4.013	4.035				
	4.077	4.098	4.077	4.097			4.027	4.013	4.036				
	4.076	4.095	4.080	4.101			4.029	4.012	4.033				
	4.079	4.096	4.079	4.098			4.031		4.034				
	4.077	4.097	4.079	4.099			4.032		4.033				
	4.078	4.094	4.080	4.100			4.027		4.034				
Av.	4.078	4.096	4.078	4.100		4.011	4.029	4.012	4.034				
(211)	5.001	5.020	5.004	5.020	+.002	4.938	4.954	4.940	4.954	+.002	+.002	.000	0%
	5.002	5.021	5.001	5.021		4.934	4.954	4.939	4.955				
	5.002	5.020	5.005	5.021		4.936	4.956	4.938	4.955				
	5.004	5.023	5.005	5.023		4.936	4.952	4.937	4.954				
	5.003	5.020	5.006	5.022		4.938	4.955	4.941	4.955				
	5.000	5.022	5.005	5.024		4.936	4.955	4.940					
	5.003	5.020	5.005	5.023		4.938	4.954	4.940					
	5.003	5.020	5.005	5.023			4.952	4.940					
	5.004	5.020	5.004	5.025			4.955	4.939					
	5.005	5.018	5.001	5.025			4.953	4.938					
Av.	5.003	5.020	5.004	5.023		4.937	4.954	4.939	4.955				
(110) 2nd order	5.785	5.810	5.791	5.810	+.003	5.740	5.766	5.745	5.760	+.001	+.002	.001	50%
	5.787	5.811	5.790	5.807		5.738	5.765	5.746	5.761				
	5.784	5.814	5.793	5.811		5.740	5.764	5.744	5.762				
	5.784	5.810	5.789	5.810		5.738	5.768	5.745	5.762				
	5.784	5.811	5.791	5.811		5.738	5.768	5.745	5.762				
	5.786	5.815	5.791	5.812			5.764		5.761				
	5.786	5.810	5.792	5.811			5.762		5.761				
	5.786	5.810	5.791	5.808			5.763		5.760				
	5.788	5.815	5.791	5.812			5.764						
	5.784	5.813	5.792	5.813			5.766						
Av.	5.785	5.812	5.791	5.811		5.739	5.765	5.745	5.761				
(310)	6.502	6.521	6.504	6.523	+.005	6.446	6.472	6.456	6.472	+.003	+.004	.001	25%
	6.501	6.520	6.506	6.504		6.451	6.470	6.455	6.471				
	6.501	6.521	6.505	6.504		6.449	6.473	6.455	6.470				
	6.504	6.517	6.506	6.506		6.450	6.469	6.455	6.472				
	6.503	6.521	6.505	6.503		6.448	6.470	6.455	6.471				
	6.503	6.518	6.506	6.505		6.451	6.471						
	6.499	6.520	6.506	6.506		6.447	6.471						
	6.501	6.518	6.507	6.506		6.447	6.473						
	6.502	6.518	6.506	6.506		6.447	6.471						
	6.500	6.522	6.507	6.504		6.450	6.472						
Av.	6.502	6.520	6.506	6.525		6.449	6.471	6.455	6.471				
(321)	7.764	7.794	7.776	7.793	+.005	7.711	7.743	7.720	7.737	+.004	+.005	.001	20%
	7.763	7.792	7.770	7.795		7.711	7.739	7.718	7.740				
	7.764	7.793	7.775	7.793		7.712	7.743	7.718	7.737				
	7.769	7.793	7.773	7.795		7.711	7.737	7.720	7.738				
	7.767	7.791	7.771	7.794		7.709	7.740	7.721	7.741				
	7.764	7.793	7.772	7.796			7.740	7.719	7.738				
	7.764	7.793	7.771	7.794			7.740		7.739				
	7.762	7.793	7.775	7.795			7.742		7.740				
	7.763	7.794	7.772	7.794			7.741		7.741				
	7.764	7.793	7.773	7.795			7.738		7.739				
Av.	7.764	7.793	7.773	7.794		7.711	7.740	7.719	7.739				

TABLE VI

Calculation of Accuracy of Measurements (Values Expressed in Inches)

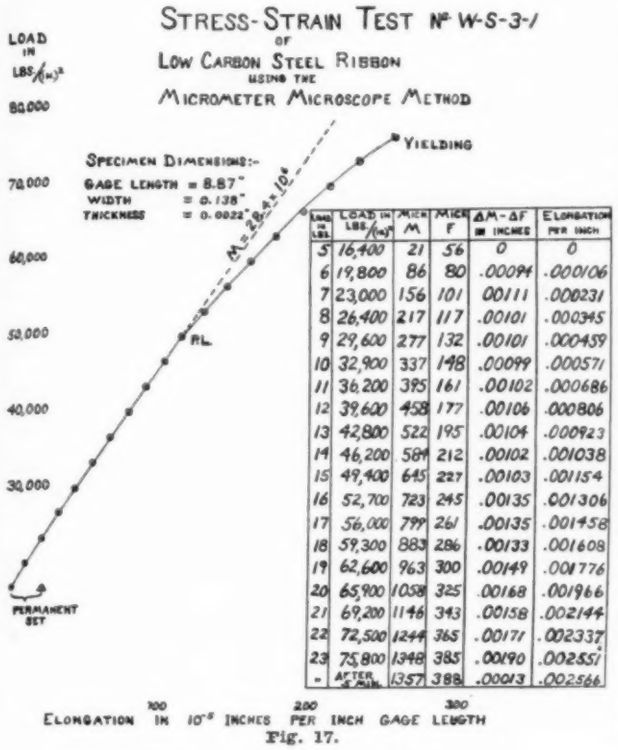
Planes	Film		A-63	A-64	A-65	A-66	A-68	A-75	A-77	A-78	A-79	A-80	A-81	A-82	A-126	A-128	A-130	Av.
(110) 1st order	Center	Original	−.004	−.002	−.002	+.001	−.002	.000	.000	+.004	+.001	.000	+.003	+.004	−.001 .000	+.003	+.006	
	Difference	Check	−.003	−.002	−.002 +.001 .000	−.001 .000	−.001 +.001	+.001	−.001	+.002 +.001	+.002	+.002 +.001	+.002	+.004	.000	+.004	+.005	
		Av.	−.003	−.002	−.001	.000	−.001	+.001	.000	+.002	+.002	+.001	+.003	+.004	.000	+.004	+.006	
	Average Deviation		.001	.000	.001	.001	.001	.001	.001	.001	.001	.001	.001	.000	.000	.001	.001	
	Limit of Accuracy Within		33%	0	100%		100%	100%		50%	50%	100%	33%	0	0	25%	17%	43%
(100)	Center	Original	−.008	−.007	−.005	−.004	−.007	+.001	−.004	−.004	+.002	+.001	−.001	+.006	−.002	+.007	+.005	
	Difference	Check	−.007 −.007	−.010 −.002 −.007	−.003	−.004	−.007 −.004	−.001 .000	−.005	.000 −.001 +.001	+.003	−.003 −.002 −.001	+.001 .000	+.005	−.004 −.003	+.006 +.004 +.007	+.005 +.004	
		Av.	−.007	−.006	−.004	−.004	−.006	.000	−.004	−.001	+.003	−.001	.000	+.006	−.003	+.006	+.005	
	Average Deviation		.001	.003	.001	.000	.001	.001	.001	.002	.001	.001	.001	.001	.001	.001	.001	
	Limit of Accuracy Within		14%	50%	25%	0	17%		25%	200%	33%	100%		17%	33%	17%	20%	43%
(211)	Center	Original	−.003 −.002	−.002	−.002	−.001	.000	+.002	−.002	+.003	+.002	+.001	+.009	+.008	−.002	+.007	+.008	
	Difference	Check	−.004	−.002	−.003	−.001	−.001 .000	+.001	−.003	+.006 +.002	+.002	+.004 .000	+.006 +.007	+.007	−.001	+.009	+.007 +.009	
		Av.	−.003	−.002	−.002	−.001	.000	+.002	−.002	+.004	+.002	+.002	+.007	+.008	−.001	+.008	+.008	
	Average Deviation		.001	.000	.001	.000	.000	.001	.001	.002	.000	.002	.001	.001	.001	.001	.001	
	Limit of Accuracy Within		33%	0	50%	0	0	50%	50%	50%	0	100%	14%	13%	100%	13%	13%	32%
(110) 2nd order	Center	Original	−.001 −.004	+.001 +.004	+.004	−.003	+.001	+.003	+.001	−.003	+.001	+.001	+.002	+.005	−.004	+.010	+.010	
	Difference	Check	.000	+.002 .000	+.003	−.001 −.003	−.001 .000	+.001	+.003	−.001	−.001	−.001	.000	+.007	−.001 −.002	+.010	+.011	
		Av.	−.002	+.002	+.004	−.002	.000	+.002	+.002	−.002	.000	.000	+.001	+.006	−.002	+.010	+.011	
	Average Deviation		.002	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001	.002	.000	.001	
	Limit of Accur. acy Within		100%	50%	25%	50%		25%	25%		50%	50%	33%	13%	100%	0	9%	41%
(310)	Center	Original	−.002 −.002	+.001	+.001	+.003		−.001	+.004	+.004	+.005	−.001	+.008	+.008	+.002	+.008	+.011	
	Difference	Check	.000	+.002	−.001	−.001	−.001 −.002	−.001	+.002	+.002	+.003	.000 +.001	+.005 +.007	+.010	+.003	+.007	+.011	
		Av.	−.001	+.002	.000	+.001	−.001	−.001	+.003	+.003	+.004	.000	+.007	+.009	+.003	+.008	+.011	
	Average Deviation		.001	.001	.001	.002	.001	.000	.001	.001	.001	.001	.001	.001	.001	.001	.000	
	Limit of Accuracy Within		100%	50%		200%	100%	0	33%	33%	25%		14%	11%	33%	13%	0	47%
(321)	Center	Original	−.001	−.005	−.005	−.001 −.002		+.005	−.001	+.010	+.005	+.003	+.004	+.008	+.002	+.012	+.015	
	Difference	Check	.000	−.004 −.004	−.006	−.005	+.004 +.003	+.006	.000	+.007 + 009	+.004	+.001	+.004 +.008 +.004 +.006	+.005 +.008 +.009	+.002	+.010	+.016	
		Av.	.000	−.004	−.005	−.003	+.004	+.006	.000	+.009	+.005	+.002	+.005	+.008	+.002	+.011	+.016	
	Average Deviation		.001	.000	.001	.002	.001	.001	.001	.001	.001	.001	.001	.001	.000	.001	.001	
	Limit of Accuracy Within			0	20%	67%	25%	17%		11%	20%	50%	20%	13%	0	9%	6%	20%

Typical results for the X-ray measurements for one of the materials are collected in Table VII.

TABLE VII Results of X-Ray Stress-Strain Tests on Low Carbon Steel Ribbon

Film No.	(110) PLANE SYSTEM 1st Order					(100) PLANE SYSTEM					(211) PLANE SYSTEM					(110) PLANE SYSTEM 2nd Order				
	Stress Intensity lbs./in.²		Av. Displacement Inches on Film	Displacement from Position at Original Load	% Elongation of Planar Spacing $\frac{\Delta d}{d}$ x100	Stress Intensity lbs./in.²		Av. Displacement Inches on Film	Displacement from Position at Original Load	% Elongation of Planar Spacing $\frac{\Delta d}{d}$ x100	Stress Intensity lbs./in.²		Av. Displacement Inches on Film	Displacement from Position at Original Load	% Elongation of Planar Spacing $\frac{\Delta d}{d}$ x100	Stress Intensity lbs./in.²		Av. Displacement Inches on Film	Displacement from Position at Original Load	% Elongation of Planar Spacing $\frac{\Delta d}{d}$ x100
	Normal to Plane System	Parallel to Plane System				Normal to Plane System	Parallel to Plane System				Normal to Plane System	Parallel to Plane System				Normal to Plane System	Parallel to Plane System			
A-90	13,700	1,200	+.004	.000	.000	13,600	2,300	+.004	.000	.000	13,500	3,000	+.001	.000	.000	13,300	3,700	+.002	.000	.000
A-91	19,900	1,800	+.007	+.003	+.105	19,700	3,300	+.005	+.001	+.025	19,500	4,400	+.002	+.001	+.020	19,300	5,400	+.002	.000	.000
A-92	24,900	2,200	+.006	+.002	+.070	24,700	4,100	+.006	+.002	+.050	24,400	5,500	+.004	+.003	+.060	24,100	6,700	+.001	−.001	−.018
A-93	29,900	2,700	+.008	+.004	+.140	29,600	4,900	.000	−.004	−.100	29,300	6,600	+.005	+.004	+.080	28,900	8,100	+.006	+.004	+.070
A-95	34,900	3,100	+.004	.000	.000	34,500	5,700	+.002	−.002	−.050	34,200	7,700	+.002	+.001	+.020	33,700	9,400	+.004	+.002	+.035
A-97	39,800	3,600	+.008	+.004	+.140	39,500	6,500	+.009	+.005	+.125	39,100	8,800	+.011	+.010	+.200	38,600	10,800	−.001	−.003	−.053
A-98	13,700	1,200	+.005	+.001	+.035	13,600	2,300	+.001	−.003	−.075	13,500	3,000	+.003	+.002	+.040	13,300	3,700	+.006	+.004	+.070
A-100	44,800	4,000	+.007	+.003	+.105	44,400	7,400	+.007	+.003	+.075	44,000	9,900	+.005	+.004	+.080	43,400	12,100	+.009	+.007	+.123
A-102	49,800	4,400	+.006	+.002	+.070	49,300	8,200	+.006	+.002	+.050	48,800	11,000	+.006	+.005	+.100	48,200	13,500	+.006	+.004	+.070
A-104	14,500	1,300	+.004	.000	.000	14,400	2,400	.000	.000	.000	14,300	3,200	+.002	.000	.000	14,100	3,900	−.005	.000	.000
A-106	49,800	4,400	+.006	+.002	+.070	49,300	8,200	+.005	+.005	+.125	48,800	11,000	+.005	+.003	+.060	48,200	13,500	+.007	+.012	+.210
A-107	54,800	4,900	+.007	+.003	+.105	54,300	9,000	+.002	+.002	+.050	53,700	12,100	+.008	+.006	+.120	53,000	14,800	+.010	+.015	+.263
A-110	14,500	1,300	+.005	+.001	+.035	14,400	2,400	−.001	−.001	−.025	14,300	3,200	+.003	+.001	+.020	14,100	3,900	+.001	+.006	+.105
A-111	59,800	5,300	+.007	+.003	+.105	59,200	9,800	+.008	+.008	+.200	58,500	13,200	+.009	+.007	+.140	57,800	16,100	+.008	+.013	+.228
A-113	64,700	5,800	+.008	+.004	+.140	64,100	10,600	+.005	+.005	+.125	63,500	14,300	+.009	+.007	+.140	62,600	17,500	+.010	+.015	+.263
A-115	69,700	6,200	+.007	+.003	+.105	69,100	11,400	+.018	+.018	+.450	68,300	15,400	+.013	+.011	+.220	67,400	18,800	+.010	+.015	+.263
A-120	74,700	6,700	+.010	+.006	+.210	74,000	12,300	+.009	+.009	+.225	73,200	16,500	+.012	+.010	+.200	72,300	20,200	+.009	+.014	+.246
A-121	79,700	7,100	+.008	+.004	+.140	78,900	13,100	+.005	+.005	+.125	78,100	17,600	+.009	+.007	+.140	77,100	21,500	+.014	+.019	+.333
A-122	14,500	1,300	+.005	+.001	+.035	14,400	2,400	+.003	+.003	+.075	14,300	3,200	+.101	−.001	−.020	14,100	3,900	+.006	+.011	+.193
A-123	84,700	7,600	+.010	+.006	+.210	83,900	13,900	+.013	+.013	+.325	83,000	18,700	+.010	+.008	+.160	81,900	22,900	+.011	+.016	+.280

Film No.	(310) PLANE SYSTEM					(111) PLANE SYSTEM					(321) PLANE SYSTEM					Weighted Av. for α Iron Crystal	
	Stress Intensity lbs./in.²		Av. Displacement Inches on Film	Displacement from Position at Original Load	% Elongation of Planar Spacing $\frac{\Delta d}{d}$ x100	Stress Intensity lbs./in.²		Av. Displacement Inches on Film	Displacement from Position at Original Load	% Elongation of Planar Spacing $\frac{\Delta d}{d}$ x100	Stress Intensity lbs./in.²		Av. Displacement Inches on Film	Displacement from Position at Original Load	% Elongation of Planar Spacing $\frac{\Delta d}{d}$ x100	Stress Intensity lbs./in.²	Av. % Elongation
	Normal to Plane System	Parallel to Plane System				Normal to Plane System	Parallel to Plane System				Normal to Plane System	Parallel to Plane System					
A-90	13,100	4,300	+.001	.000	.000	12,900	4,800	−.003	.000	.000	12,700	5,300	+.003	.000	.000	13,800	.000
A-91	19,000	6,300	+.003	+.002	+.030	18,700	7,000	+.003	+.006	+.084	18,400	7,700	+.002	−.001	−.013	20,000	+.020
A-92	23,800	7,800	+.002	+.001	+.015	23,400	8,800	+.003	+.006	+.084	23,000	9,700	+.006	+.003	+.039	25,000	+.039
A-93	28,500	9,400	+.001	.000	.000	28,100	10,500	+.002	+.005	+.070	27,700	11,600	+.004	+.001	+.013	30,000	+.037
A-95	33,200	10,900	+.008	+.007	+.105	32,800	12,300	+.002	+.005	+.070	32,300	13,600	+.018	+.015	+.195	35,000	+.097
A-97	38,000	12,500	+.007	+.006	+.090	37,500	14,000	.000	+.003	+.042	36,900	15,500	+.006	+.003	+.039	40,000	+.082
A-98	13,100	4,300	+.003	+.002	+.030	12,900	4,800	+.003	+.006	+.084	12,700	5,300	+.013	+.010	+.130	13,800	+.070
A-100	42,800	14,100	+.008	+.007	+.105	42,200	15,800	+.003	+.006	+.084	41,500	17,400	+.007	+.004	+.052	45,000	+.081
A-102	47,500	15,600	+.005	+.004	+.060	46,900	17,500	+.011	+.014	+.196	46,100	19,400	+.010	+.007	+.091	50,000	+.088
A-104	13,900	4,600	.000	.000	.000	13,700	5,100	−.002	.000	.000	13,500	5,700	.000	.000	.000	14,600	.000
A-106	47,500	15,600	+.009	+.009	+.135	46,900	17,500	+.006	+.008	+.112	46,100	19,400	+.006	+.006	+.078	50,000	+.100
A-107	52,300	17,200	+.008	+.008	+.120	51,500	19,300	+.012	+.014	+.196	50,700	21,300	+.010	+.010	+.130	55,000	+.136
A-110	13,900	4,600	−.001	−.001	−.015	13,700	5,100	.000	+.002	+.028	13,500	5,700	+.009	+.009	+.117	14,600	+.056
A-111	57,000	18,700	+.014	+.014	+.210	56,200	21,000	+.014	+.016	+.224	55,400	23,200	+.014	+.014	+.182	60,000	+.180
A-113	61,800	20,300	+.011	+.011	+.165	60,900	22,800	+.013	+.015	+.210	59,900	25,200	+.006	+.006	+.078	65,000	+.137
A-115	66,500	21,900	+.013	+.013	+.195	65,600	24,500	+.012	+.014	+.196	64,500	27,100	+.004	+.004	+.052	70,000	+.158
A-120	71,300	23,500	+.019	+.019	+.285	70,300	26,300	+.012	+.014	+.196	69,100	29,100	+.013	+.013	+.169	75,000	+.210
A-121	76,000	25,000	+.018	+.018	+.270	74,900	28,000	+.026	+.028	+.392	73,800	31,000	+.019	+.019	+.247	80,000	+.233
A-122	13,900	4,600	+.004	+.004	+.060	13,700	5,100	.000	+.002	+.028	13,500	5,700	+.004	+.004	+.052	14,600	+.051
A-123	80,800	26,600	+.012	+.012	+.180	79,600	29,800	+.002	+.004	+.056	78,400	32,900	+.017	+.017	+.221	85,000	+.202



Load in Lbs.	Load in Lbs/(in)²	Micr. M	Micr. F	ΔM−ΔF in inches	Elongation per inch
5	16,400	21	56	0	0
6	19,800	86	80	.00094	.000106
7	23,000	156	101	.00111	.000231
8	26,400	217	117	.00101	.000345
9	29,600	277	132	.00101	.000459
10	32,900	337	148	.00099	.000571
11	36,200	395	161	.00102	.000686
12	39,600	458	177	.00106	.000806
13	42,800	522	195	.00104	.000923
14	46,200	589	212	.00102	.001038
15	49,400	645	227	.00103	.001154
16	52,700	723	245	.00135	.001306
17	56,000	799	261	.00135	.001458
18	59,300	883	286	.00133	.001608
19	62,600	963	300	.00149	.001776
20	65,900	1058	325	.00168	.001966
21	69,200	1146	343	.00158	.002144
22	72,500	1244	365	.00171	.002337
23	75,800	1348	385	.00190	.002551
-	After 5 Min.	1357	388	.00013	.002566

Fig. 17.

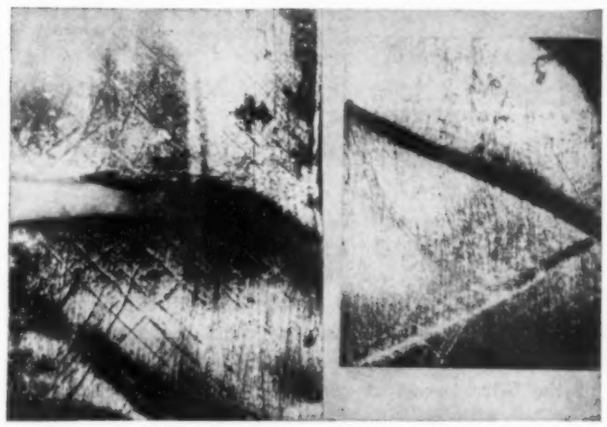


Fig. 18. Characteristic Features of the Steel Ribbons.
Note that Luders Lines are shown, according to Aicheson. The presence of these lines indicates uniformity of loading.

All of the stress-strain data for the crystals are collected in the curves of Figs. 13, 14, 15, 16 and 17.

The lines selected for measurement were those whose edges were sufficiently sharp to make settings with a fair degree of certainty. It was found possible to measure only three lines of the blued stock, seven of the low carbon, and six of the annealed stock films. The lines of the (111) planes were weak and were not measured for this reason in the films from the annealed stock. In Table VIII average moduli for the various planes are given. These represent average values of the ratios of stress to strain for the different experimental points except that for low stress values the strains measured were not sufficiently accurate to be considered in the modulus determinations.

TABLE VIII

Comparison of Observed Moduli of Elasticity x 10^{-3} lbs./in.^{2}

Plane System		Blued Shim Stock	Annealed Shim Stock	Low Carbon Steel Ribbon
(110) 1st order	Av. M from Diagrams	6	12	11
	Av. M Calc'd from original load	Calc'd from zero load 22	22	33
(100)	Av. M from Diagrams	9	9	13
	Av. M Calc'd from original load	20	25	36
(211)	Av. M from Diagrams	18	15	18
	Av. M Calc'd from original load	25	35	37
(110) 2nd order	Av. M from Diagrams		14	13
	Av. M Calc'd from original load		55	26
(310)	Av. M from Diagrams		14	17
	Av. M Calc'd from original load		58	31
(111)	Av. M from Diagrams			7
	Av. M Calc'd from original load			31
(321)	Av. M from Diagrams		12	8
	Av. M Calc'd from original load		51	46
Weighted Av. for α Iron Crystal	Av. M from Diagrams	14	19	17
	Av. M Calc'd from original load	23	43 (Av. of upper 10 points)	33

(Part III of this article will be published in the January-February, 1926, issue of this Journal.)

Editorial

The Ordnance Budget

IN spite of the fact that the Budget and Accounting Act is entering upon its fifth year of operation, the Budget activities of the Federal Government, the War Department and the Ordnance Department still remain a mystery to many persons. Little has been said or written to dispel the popular impression that Budget matters are secret and confidential. The meetings of the Business Organization of the Government, at which two of our Presidents have presided with two successive Directors of the Bureau of the Budget, have served to enlighten the public as to the aims, hopes and ambitions of the Bureau established to administer the Budget and Accounting Act.

The Budget Officer for the War Department, Maj. Gen. Kenzie W. Walker, has been good enough to contribute to this issue an article which answers many questions about the operations of the War Department Budget organization. Within the Ordnance Department itself every individual, from the Chief of Ordnance at the head of his office in Washington to the responsible enlisted man or civilian serving in the Philippine jungles, feels sometime during each year the effect of the Budget. The planning and announcement of the annual Ordnance program, the building of the preliminary estimate for funds, the defense of the estimates, the sub-division into primary and supplemental estimates, and the hearings before the numerous Ordnance, War Department, Executive and Legislative echelons of the Budget organization make us realize that the Budget is always with us.

The first phase, that is the portion of the Budget procedure which precedes the appropriation of funds for the fiscal year 1927, began in December, 1924, and will continue until the President signs the appropriation bill.

The mission of the Ordnance Department includes the supply of ordnance to the Army in both peace and war, the maintenance of ordnance in serviceable condition, the improvement of items of ordnance equipment, and adequate preparation through intelligent planning for mass production of ordnance necessary in the event of war. To accomplish his mission the Chief of Ordnance requires funds in sufficient quantities to employ suitable personnel and keep in operation industrial and military organizations and facilities, including arsenals, depots, proving grounds and commercial plants.

Included in the appropriations for the Ordnance Department for the past twenty years are the following:

1906	$ 8,126,418	1916	$14,947,110
1908	10,545,468	1923	6,859,030
1910	10,093,856	1924	5,812,180
1912	8,794,474	1925	7,751,272
1914	9,503,641	1926	7,543,802

The preliminary work on the 1927 Budget has emphasized very greatly that, in the case of the war reserve of ammunition, unless steps are taken to bring in the back door new ammunition to replace that going out the front door, the stocks of ammunition in the storehouses will soon become exhausted and the military effort of this country might be nullified through lack of ammunition. To properly maintain an ammunition reserve will entail an increased annual expenditure. The extent to which the Army has been able to carry on its training activities, utilizing World War stocks with saving of current appropriations, is especially noticeable in the case of rifle and field gun ammunition.

With the Executive approval of the appropriation bill the 1927 Budget passes into its second phase and the Ordnance Department will be specifically interested in the apportionment of funds carried by the appropriation Act, their allotment to active Ordnance projects, the issue of procurement authorities authorizing the specific purchases, manufacture and services, and will concentrate its effort on the supervision of Ordnance activities to insure efficient and economic use of the funds provided.

The Secretary of War recently announced his intention to vary the War Department procedure in formulating the 1928 Budget. His plan calls for a meeting of the War Council, created by the National Defense Act and consisting of the Secretary of War, the Assistant Secretary of War, the General of the Army and the Chief of Staff, for the purpose of initiating the General Army Program for the year. The General Program transmitted to the Budget Officer for the War Department serves as a basis for the preparation of the detailed preliminary estimates to be prepared by the several Branches of the Army. The Budget Officer for the War Department consolidates the preliminary estimates submitted by the Chiefs of War Department Branches and transmits the preliminary War Department estimate to the Secretary of War in the War Council through the Assistant Secretary of War and the Chief of Staff.

This proposed procedure should very greatly simplify the first phase of the 1928 Budget and Secretary Davis further proposes to revise the procedure for the second phase, or the supervision of expenditures, by calling upon each Chief of Branch to prepare a program of expenditures based upon the War Department Program, the Budget and the appropriation Act, this program to be forwarded through the Assistant Secretary of War and the Chief of Staff to the War Council for action and approval by the Secretary of War.

Let us hope that, as our experience with the Budget continues, we shall approach the ideal condition of having at all times a clearly defined program, the funds to carry it out, and an organization and procedure adequate to insure efficient execution.

Seventh Annual Meeting A. O. A.

NOW that our Seventh Annual Meeting is history, there are a great many reflections that can be made as to its success. In point of attendance, the meeting was practically double that of any of our previous gatherings; it has been conservatively estimated that there were two thousand persons present. A definite indication of the attendance can be gathered from the fact that the sale of meal tickets this year was practically double that of the last; there were nearly one thousand who sat down to dinner. There are always a great many who take their meals elsewhere or in picnic fashion at the Proving Ground so that our estimate of attendance is not at all unreasonable.

Thanks to the excellent coöperation of the Commanding Officer of the Proving Ground, Lt. Col. Charles M. Wesson, and his staff, the entire program of events was very efficiently conducted. When one considers that the demonstrations included the whole field of ordnance from exhibitions of small arms to maneuverings and firing of the 16-inch seacoast gun, it can be readily understood that the execution of such a program requires excellent organization and dependable personal coöperation.

From all sources, particularly from the visiting organizations, which included the National Machine Tool Builders' Association, the National Aeronautic Association, the Franklin Institute of Philadelphia, the Pennsylvania Section of the American Society of Automotive Engineers, and Reserve Officers of the 79th Division, nothing but the highest praise has been received.

Taking all these factors into consideration, the outstanding impression is this: that the annual meeting of the Army Ordnance Association has become the principal ordnance activity of the year. It is an established event where members gather to renew old acquaintances and to see exhibited the latest developments of all phases of ordnance. It has become the great rallying day of the year and is a tribute to those who founded and have continued in the work of the Army Ordnance Association, and is likewise an inestimable help to the cause of ordnance preparedness.

It is only necessary to recall that such an annual gathering ten years ago was unheard of. Now our meetings bring together men of affairs, executives and engineers from all sections of the country who are willing to testify to their interest in this important branch of national defense. Charter members of the Association who, in 1919, assisted in its formation, can well compliment themselves upon a task well begun, and members who have affiliated themselves with the Association since that time have the happy assurance that they are aiding a very worthy cause.

The Army Ordnance Association is now an established institution. It has survived the trials and tribulations of its early days, its annual meetings have taken their place in the front rank of preparedness gatherings, the aims and objectives toward which it is continually striving have increased in importance with the passing of years. Its future, judging by the past, augurs well for adequate national defense.

Army Ordnance: A Book of Reference

THOSE members of the Army Ordnance Association who have saved their copies of ARMY ORDNANCE realize the reference value of the accumulated numbers. Bound they make a very formidable collection of data not to be found elsewhere.

With this issue of our journal you are being supplied with a copy of the index to Volume II. Indexes to Volumes I to IV, inclusive, have now been published. May we suggest the propriety of having your numbers bound, in which form their value is greatly increased? It is proposed to issue indexes to all future volumes with the concluding number of each.

Another Local Post

AS this issue of ARMY ORDNANCE goes to press, plans are being formulated for the establishment on November 18th of the Washington Post of the Army Ordnance Association. Gen. James A. Drain, Past Commander of the American Legion, has accepted the nomination for Presidency of the Post, and Maj. Charles G. Mettler has been nominated as Vice-President. All indications are that the new unit will have a most auspicious beginning and will do yeoman service in the interests of national defense in the Capital.

With the inauguration of this latest local post, the Army Ordnance Association now has units in Boston, New York, Chicago, San Francisco and Washington. Certainly there can be no better media for maintaining the interest and personal contact between members of the National Association than by such local organizations. The effectiveness of the Army Ordnance Association can be increased only as the personal interest of its members grows.

Let us hope that the day is not far distant when many of the larger cities where members of the Army Ordnance Association reside in sufficient numbers to warrant the establishment of a post, will have their own local organizations. Eastern states are already represented with three, the Central states have one, and the West Coast one. Who's next?

Navy Day, 1925

THE observance of Navy Day this year was a wholehearted and enthusiastic occasion—typical of all that the Navy does. The Navy Department is to be congratulated on the excellent fashion in which the nation-wide—nay, world-wide—arrangements were made, and those patriotic citizens who joined in the tribute are likewise entitled to sincere commendation.

When all is said and done, the setting aside of one day of the year to a consideration of our great "First Line of Defense" is but meagre tribute at best. Our Navy—her history, her gallant record of ships and men; her place in the traditions of the sea, and her present attainments—these are by-words throughout the land. To honor this bulwark of our defense is worthy emulation of nations of old and bespeaks a national interest in peace insurance which well becomes us.

Elsewhere in this issue tribute is paid to "Old Ironsides," that historic vessel which so nobly typifies naval tradition. In honoring this good ship let us pledge anew our devotion to the Navy and wish for it an ever-increasing place in the esteem and affection of our people so that Navy Day in future will be even greater in significance than in the past.

Reserve Corps Notes

Items of Interest to Members of the Ordnance Department Reserve

Edited by Major John A. Brooks, Jr., Military Personnel Section, Office of the Chief of Ordnance

Rock Island Arsenal Reserve Officers' Training Camp, 1925

AS indicated in the September - October issue of ARMY ORDNANCE, the Reserve Officers' Training Camp was held at Rock Island Arsenal, August 16th to 30th, inclusive. Forty officers were present. The instruction was similar to that given at Aberdeen Proving Ground taking into account the differences between the two establishments. The subjects for the various classes and instructors were as follows:

At Rock Island Arsenal:

Address of Greeting and Rock Island Arsenal—Its Organization, Growth and Additional Requirements.....Col. D. M. King
Tour of inspection about the arsenal.
Mooile Artillery.....Lt. Col. G. H. Stewart
Small Arms and Machine Guns..Capt. W. R. Slaughter
Small Arms and Machine Gun Firing, Capt. W. R. Slaughter
Field Service Activities.....Maj. P. G. Blackmore
Pistol Practice.....Lt. J. M. Erwin
Fire Control Instruments.....Maj. F. A. Englehart
Tanks, Tractors and Motor Carriage Artillery, Capt. H. A. Nisley
Chronographs and Proof Firing....Capt. E. C. Goebert
Ordnance Company—Heavy Maintenance, Its Equipment and Work.....Lt. J. M. Erwin
Military Courtesy and Customs of the Service, Maj. F. A. Englehart

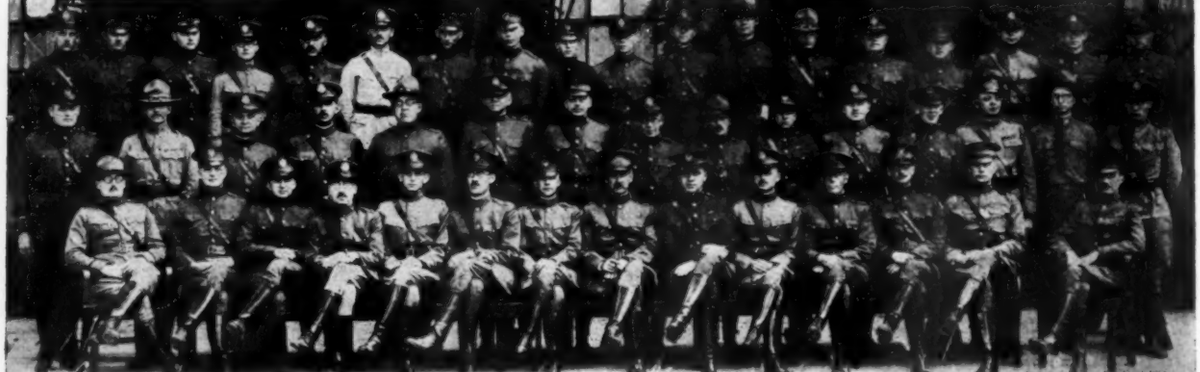
At Savanna Proving Ground:

Ammunition—Its Storage and Transportation, W. O. Piercy and Tech. Sgt. Luker
Surveillance Tests and Powder Laboratory, Lt. H. P. Stewart
Storage of Vehicles and Inspection of Shops, Mr. Utts
Savannah Proving Ground—Its Organization, Growth and Future Use.....Maj. G. F. Lemon

In addition to the above instruction one-half hour of infantry drill was given each morning at Rock Island Arsenal and one hour of drill while at Savanna Proving Ground.

The stone barracks of the 33rd Ordnance Company were used for the Headquarters of the Camp and quarters for the Reserve Officers. In past years the officers had obtained their meals at the company mess but as this was not entirely satisfactory, the Arsenal Cafeteria was used for this purpose this year. The stone barracks and cafeteria being approximately one-half mile apart gave the officers a pre-breakfast walk to whet their appetities in lieu of the customary calisthenic exercises given at most camps.

The officers were given an opportunity to see all parts of the arsenal and it is no exaggeration to say that they



Ordnance Reserve Officers who attended Rock Island Arsenal Training Camp, 1925.

Top row (left to right): 1st Lt. R. S. Haggard, Ord. Res.; 1st Lt. L. Hedges, Ord. Res.; 1st Lt. C. E. Heimbrodt, Ord. Res.; 1st Lt. W. Kendall, Ord. Res.; 1st. Lt. R. E. N. Marks, Ord. Res.; 1st Lt. G. A. Moshchansky, Ord. Res.; 2nd Lt. N. O. Bradley, Ord. Res.; 2nd Lt. R. R. Byer, Ord. Res.; 2nd Lt. S. O. Fiedler, Ord. Res.; 2nd Lt. G. C. Fowler, Ord. Res.; 2nd Lt. W. B. Hobbs, Ord. Res.; 2nd Lt. J. A. Peterson, Ord. Res.; 2nd Lt. H. T. Prothero, Ord. Res.; 2nd Lt. C. Z. Rosecrans, Ord. Res.; 2nd Lt. E. F. Seiller, Ord. Res.; 2nd. Lt. F. S. Sutherland, Ord. Res.; 2nd Lt. F. M. Thrun, Ord. Res.; 2nd Lt. T. E. Xistris, Ord. Res.

Middle row: Maj. E. H. Lichtenberg, Ord. Res.; Maj. C. F. Queisser, Ord. Res.; Maj. E. E. Snare, Ord. Res.; Capt. W. H. Damon, Ord. Res.; Capt. C. M. Haines, Ord. Res.; Capt. H. B. McKahin, Ord. Res.; Capt. C. A. Meyer, Ord. Res.; Capt. F. A. Mickle, Ord. Res.; Capt. T. E. Moon, Ord. Res.; Capt. C. E. Watts, Ord. Res.; Capt. F. R. Zimmerman, Ord. Res.; 1st Lt. H. S. Beatty, Ord. Res.; 1st. H. T. Chapin, Ord. Res.; 1st Lt. L. C. Eddy, Ord. Res.; 1st Lt. J. D. Frost, Ord. Res.;

Seated: Maj. J. D. Polley, Ord. Res.; Maj. F. S. Blue, Ord. Res.; Maj. L. A. Daerr, Ord. Res.; Maj. A. W. Draves, Ord. Res.; Maj. P. G. Blackmore, U. S. A.; Maj. F. A. Englehart, U. S. A.; Capt. W. R. Slaughter, U. S. A.; Col. D. M. King, U. S. A.; Capt. E. C. Goebert, U. S. A.; 1st. Lt. J. M. Erwin, U. S. A.; Maj. J. B. Fitzgerald, Ord. Res.; Maj. A. K. Hamilton, Ord. Res.; Maj. H. B. LaRue, Ord. Res.; Lt. Col. G. H. Stewart, U. S. A.

were duly impressed by the magnitude of the establishment with its tremendous shops, store houses, hydro-electric and steam power plants, water supply system and railway facilities. The fact that so many shops were closed, on account of lack of work, had a depressing effect upon them besides making it impossible for them to see many of the operations required in the manufacture of Ordnance matériel.

The instruction that was given was made as practicable as possible having the officers actually perform the work of the disassembling, reassembling and testing wherever possible. They soon learned that to properly perform their work it was necessary for them to wear fatigue clothes. Ordnance pamphlets for all of the material being studied had been procured and were made available to the officers as reference books during the course of the camp.

In preparing the course at Rock Island Arsenal it was realized that that part of it pertaining to ammunition and its storage could not be properly impressed upon the officers at the Arsenal proper and therefore a trip to Savannah Proving Ground was planned. Accordingly, on Sunday morning, August 23rd, about 9 o'clock all of the officers, under the supervision of Capt. H. A. Nisley, boarded a river steamer belonging to the Corps of Engineers and were so transported up the river. On this trip a representative from the Engineers Corps explained the work of that Corps in making the Mississippi River navigable. The return trip was made on the following Wednesday. From remarks made by the officers, this trip was well worth while.

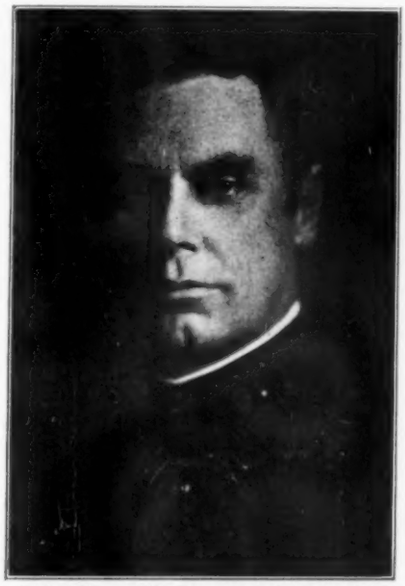
The actual work of instruction was completed at 3 P. M. with the exception of a few lectures, and the officers found time to enjoy the well kept eighteen hole golf course on the Arsenal to which they had been given full privileges. Approximately one-half of the officers attended the regular dinner dance at the Rock Island Arsenal Golf Club House, August 20th, which was enjoyed by all.

On Wednesday evening, August 26th, a stag dinner was given by the Reserve Officers at the Hotel Blackhawk, Davenport, Iowa, to which all of the regular Army officers of the Arsenal were invited. This latter event showed quite conclusively that the officers of the camp, many of whom had come from distant points and had not known one another previously, had become good friends and would long remember the friendships made at the camp.

In general, the camp was a decided success and those officers who are assigned to Rock Island Arsenal in case of an emergency expressed a desire to return for the purpose of taking up more advanced work in their individual assignments. The morale of the camp was excellent.

General Delafield Again Heads Reserve Officers' Association

BRIG. GEN. JOHN ROSS DELAFIELD, Ord. Res., former Chief of the New York Ordnance District, was unanimously reelected president of the Reserve Officers' Association of the United States at the closing session of its national convention on October 3 at Kansas City, Mo. This is the third term for General Delafield. He had indicated that it was his desire to retire from the presidency this year, stating that he thought that his retirement would be in the interest of the Association, but that his keen interest in the welfare of that body would continue. The two leading candidates, Brig. Gen. Roy Hoffman, of Oklahoma City, and Col. Arthur J. Elliott, of Kansas City, withdrew when it was found that General Delafield was the unanimous choice of the delegates.



Brig. Gen. John Ross Delafield, Ord. Res.

Other officers chosen were: First vice-president, Brig. Gen. Roy Hoffman, Oklahoma City; second vice-president, Lt. Col. Noble Brandon Judal, Chicago; third vice-president, Col. John Hawkins, Pittsburgh; secretary, Lt. Col. Fred B. Ryons, Washington, D. C.; treasurer, Maj. Roy F. Bessey, Washington, D. C.

General Delafield is a well-known lawyer, being the senior member of the law firm of Delafield, Thorne & Burleigh, of New York City. He has always devoted himself unstintingly and unselfishly to the interests of adequate national defense. During the Spanish-American War, General Delafield was colonel of a regiment of the New York Guard, which he had reorganized. During the World War he accepted a majority in the Ordnance Department. Later he was appointed chairman of the Board of Contract Adjustment of the War Department. He reorganized the board and completed its work. He was commissioned in the Officers' Reserve Corps and appointed chief of the New York Ordnance District, and was later promoted to brigadier general in the Officers' Reserve Corps.

General Delafield has been decorated by the President of the United States with the D. S. M., by the Republic of France with the Cross of Officer of the Legion of Honor, and by the State of New York with the Conspicuous Service Cross. He holds the degree of Bachelor of Arts, Princeton, and Bachelor of Laws, Harvard.

New Ordnance R. O. T. C. Unit at Lehigh University

IT is appropriate at this time that the new Ordnance R. O. T. C. Unit of Lehigh University should be introduced to its contemporaries.

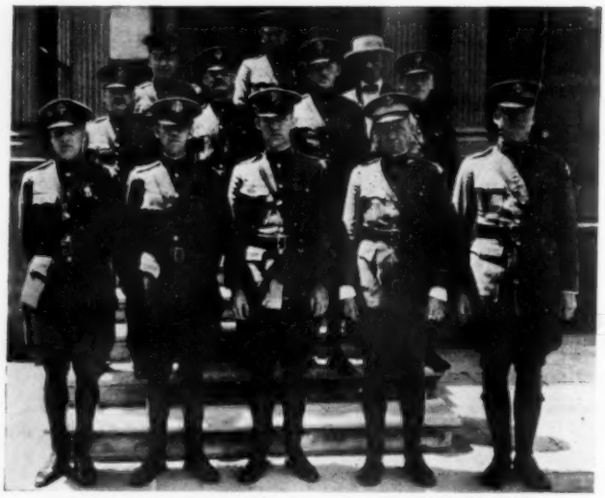
Though the Unit is at present limited to fifty students, only ten of which may be enrolled in the Advanced Course, the department is indeed fortunate that the excellent engineers developed at Lehigh are thus made available for Ordnance work.

The Ordnance Course of the present year was announced only on the eve of registration, but even without any special publicity, the number of students who applied indicated that the course will be more than popular with the engineering students, without detracting from the success of the Infantry Unit already in operation.

The Lehigh Faculty, too, from President Richards down, has already evidenced its complete co-operation with Lt. T. R. Taber, Ord. Dept.,

U. S. A. (D. O. L.), Ordnance Officer in charge, by adapting advanced problems in design or technique to Ordnance Department work.

With this coöperative spirit, the interest of the student body and the ideal location of the University in the heart of a great manufacturing district, it seems certain that the members of the Unit just started will be heard from in years to come.



Ordnance Reserve Officers who attended Benicia Arsenal Training Camp, 1925.

University of California Ordnance Training Camp, 1925

THE 1925 Summer Ordnance Camp of the University of California was held from June 20th to July 30th. It was a great success. Every one of the nineteen members has voiced his opinion of having had a wonderful and worthwhile summer vacation.

The camp was held, as last year, at Fort Casey, Washington. Ordnance activities were under the direction of Major Pinger, Major Spalding, and Captain Atwood. Major Pinger is in charge of Ordnance at the University. Major Spalding at present has charge of the Ordnance Reserve Officers of the Ninth Corps Area at San Francisco. Captain Atwood is starting a unit similar to California's at Stanford.

The camp was informal as the main object was to gain technical information about ordnance problems. This year every man had to drill at least one-half hour a day. Most of the time was taken up in firing the guns available for the unit. The types of guns that were fired were: 12-inch mortars; 10-inch coast defense rifle; 3-inch seacoast; 3-inch antiaircraft; 3-inch field; 75-mm.; 155-mm.; 37-mm. (French type), and the Stokes trench mortar. The different types of small arms were fired and tested. Different types of explosives, grenades, bombs, and pyrotechnics were studied in order that the men could become familiar with the characteristics of each. Practically all the men had a chance to fire one of the types of ordnance.

The principal object of firing the many types of guns was to obtain data for pressure velocity curves, charge range curves, and other important information about ordnance problems. This year Major Pinger devised a machine which automatically drew a recoil-time curve as the gun recoiled and counter-recoiled. It worked well for all types of guns.

The Aberdeen Chronograph in conjunction with a group of screens erected in front of the guns was used to determine the velocity of the projectile as it left the gun. By use of this instrument the velocity of the concussion wave which moves outward from the blast was determined.

The week at Camp Lewis was the fifth week of the camp. All the members had some practice with the tanks, which they greatly enjoyed. The unit also observed the actual explosion of the 8-inch shells and 75-mm.'s shrapnel at close range under a bombproof. The 75-mm., 3-inch and 8-inch shells were exploded under ground to determine the degree of fragmentation. The unit also observed the operation and had actual practice with ordnance supply and repair trucks.

During the week-end at Camp Lewis the unit was given a treat by going up to Mt. Ranier. Another trip was to Bremerton Navy Yard when the men observed how the Navy handles its ordnance and other related problems.

Amusements were not lacking at camp. Nearly every Wednesday and Saturday afternoon the men could participate in baseball, track, golf, or other forms of sport. Three times a week the Army gave a good moving picture show at the Army Club. About three-fourths of the men went up to Victoria, and it seemed when one observed the empty pocketbooks that enjoyments were plentiful. Health conditions were excellent at the Fort; and with the hard work and the pure fresh sea air from the Straits of Juan de Fuca every one had an enormous appetite.—(*California Engineer, September*, 1925.)

Ordnance Reserve Officers' Training Camp, Benicia Arsenal, 1925

A TRAINING camp for Ordnance Reserve Officers was held at Benicia Arsenal the last two weeks of June which the following officers attended: Lt. Col. M. M. Mitchell, 706 W. 47th St., Los Angeles, Cal.; Capt. W. E. Robinson, 216 East Hill St., Long Beach, Cal.; 2nd Lieut. R. F. Bagley, 1002 Black Bldg., Los Angeles, Cal.; 2nd Lieut. Jesse A. Bell, Marysville, Cal.; 2nd Lieut. R. C. Scott, 2146 W. Adams St., Los Angeles, Cal.; 2nd Lieut. B. O. Garrett, Oregon City, Ore.; 2nd Lieut. W. H. Gerretson, Roseburg, Ore.; 2nd Lieut. F. B. McNeil, First National Bank, Durango, Colo.

Of the above officers, Captain Robinson is assigned to the Ammunition Section, and Lieut. McNeil to the Tank, Tractor and Trailer Section of the St. Louis District Ordnance Office. The remaining officers are in the Territorial Assignment Group, all of them being assigned to the 9th Corps Area, one as a Corps Ordnance Officer, one to a depot company, one to a heavy maintenance company and the others to light maintenance companies.

The course of instruction was the same for all officers. The schedule was as follows:

MONDAY, JUNE 15TH

8 A. M. to 9 A. M.—Physical Examination.

9 A. M. to 11 A. M.—General Inspection of Arsenal, Major Smith, Major Partridge.

11:15 A. M. to 12 M.—Talk, "Organization and Functions of Benicia Arsenal," Major Smith.

1:15 P. M. to 3:30 P. M.—Talk and discussion, "Organization of a Field Army Corps, and Infantry Division, with Special Reference to Organization and Duties of the Ordnance Officer Assigned to These Units," Major Partridge.

TUESDAY, JUNE 16TH

7:30 A. M. to 12 M.—Inspection of small arms repair shop; demonstration and explanation of the various repairs and adjustments; display and explanation of all types of pistols, rifles, and automatic arms. Capt. Merrill and Mr. Eversole.

1:15 P. M. to 3:30 P. M.—Talk and discussion, "Property Accounting; the Ordnance Provision System." Mr. O'Donnell, Mr. Gieffels.

WEDNESDAY, JUNE 17TH

7:30 A. M. to 12 M.—Inspection of storage and issue of Ordnance Supplies, Groups A, B, C, D, E, F, G, and H. (Storehouses 71, 69, 63 and 49.) Explanation of the methods of storage of the various classes of supplies; inspection, checking and packing property, disposition of unserviceable supplies; inventories. Capt. Merrill, Mr. O'Donnell.

Wednesday afternoon—Recreation.

THURSDAY, JUNE 18TH

7:30 A. M. to 12 M.—Talks: Organization and Functions of Ordnance Maintenance Companies, light and heavy, under the several assignments. Specialists, duties. Tool and Stock Problem with reference to Standard Nomenclature Lists, Special Repair Tools. Maintenance Operations with reference to Ordnance Field Service Bulletins, particularly No. 4. Field Service Modification Work Orders. Display and inspection of light mobile shop and heavy shop equipment. Lieut. Hirsch.

1:15 P. M. to 3:30 P. M.—Illustrated Talk, "Industrial Accident Prevention," Motion Picture, "King Carelessness," Mr. Bary, California Industrial Commission.

FRIDAY, JUNE 19TH

7:30 A. M. to 12 M.—The 75-mm. Gun M-1897 (French). Dismount, explaining wearing parts and repairs as parts are reached. Reassemble, make recuperator tests (air pressure, friction of floating piston, friction of recoil piston and recoil rod stuffing box). Special repair tools. Examination of limbers, caissons, battery reels, etc. Lieut. Hirsch.

1:15 P. M. to 3:30 P. M.—Talk by Colonel Shinkle, Corps Area Ordnance Officer, 9th Corps Area. Talk by Major Brett, Executive Assistant, San Francisco District Ordnance Office.

Note.—Owing to inability of Colonel Shinkle and Major Brett to attend the following was substituted:

1:15 P. M. to 3:30 P. M.—Demonstration of 5-ton tractor and 6-ton tank. Each officer was given instructions in driving these vehicles after which they were required to operate them.

SATURDAY, JUNE 20TH

7:30 A. M. to 11:30 A. M.—Visit to Mare Island Navy Yard. Inspection of the Shops and of a Submarine; Inspection of Naval Ammunition Depot.

MONDAY, JUNE 22ND

7:30 A. M. to 8:15 A. M.—Talk, "Ammunition Supply in Peace and War; Description of Depots and Parks." Major Partridge.

8:30 A. M. to 12 M.—Inspection of ammunition magazines, accompanied by talks on methods of handling and storing various classes, and description of ammunition and its markings; breaking down unserviceable small arms ammunition; demolition of unserviceable ammunition, destruction of "duds," etc. (Talk and demonstration), Major Partridge.

1:15 P. M. to 2:15 P. M.—Talk, "Arsenal Administration," Mr. Mann.

2:30 P. M. to 3:30 P. M.—Talk, "Development of Ordnance Since the World War" with slides. Major Partridge.

TUESDAY, JUNE 23RD

7 A. M. to 12 M.—The 155-mm. Howitzer. Recuperation. Dismantle, examine liquid and air cylinders, pistons, recoil control, reassemble, fill with liquid and air and demonstrate tests to determine liquid level and air pressure; breech block and obturation; construction of gun.

1:15 P. M. to 3:30 P. M.—Demonstration firings 3-inch Stokes Mortar, 37-mm. Gun, Browning machine gun, Browning Automatic Rifle, Caliber .30 Pistol, Very Pistol, and Cal. .22 gallery practice rifle M-1922. After demonstration, functioning and operation of each weapon were explained and each officer was required to fire one or more rounds from each. Capt. Merrill.

WEDNESDAY, JUNE 24TH

7:30 A. M. to 12 M.—Critique—Each officer was required to write a report on the course of instruction given at the Arsenal covering either the course in general, or any particular phase or phases of it which may have especially interested the individual. Comments on the course with suggestions for changes or improvements were invited.

Wednesday Afternoon—Recreation.

Note.—For those who desired, arrangements were made for instruction in pistol and rifle practice, beginning at 3:45 P. M. each afternoon. Capt. Merrill.

THURSDAY, JUNE 25TH

All Day—Visit to the San Francisco District Ordnance Office. Talk on Organization and Functions of the Office. Discussions on War-time procurement of Ordnance, and Industrial Mobilization. Major Brett.

FRIDAY, JUNE 26TH

All Day—Visit to Corps Area Ordnance Office, Presidio of San Francisco, Organization and Functions of Corps Area Ordnance Office. Colonel Shinkle.

SATURDAY, JUNE 27TH

Settlements of pay and mileage accounts at Fort Mason.

This course fairly well covered the activities at Benicia Arsenal which would be of interest or value to Ordnance Reserve Officers. Not all of the topics covered have a direct application to the specific assignment of any one of the officers. However, it was manifestly impossible to conduct specialized courses for each of the officers. An endeavor was made to cover the ground of ordnance work insofar as facilities existed at the Arsenal, with a view to stimulating the interest of these officers in ordnance work in general.

Recently Commissioned Ordnance Reserve Officers

THE following have accepted reserve commissions since last issue of ARMY ORDNANCE:

Lieut. Col. Charles W. Nunan, Ord. Res.,
408 North Elm St., Champaign, Ill.

Lieut. Col. Theodore Swann, Ord Res.,
3211 Cliff Road, Birmingham, Ala.

Maj. Joseph S. Bates, Ord. Res.,
224 Haverford Ave., Swarthmore, Pa.

Maj. Harry P. Caswell, Ord. Res.,
2109 Cleveland Ave., Chicago, Ill.

Maj. Beveridge C. Dunlop, Ord. Res.,
Union Ave., Spring Valley, N. Y.

Maj. William R. Ham, Ord. Res.,
Boalsburg, Pa.

Maj. Jep C. Hardigg, Ord. Res.,
c/o Prat-Daniel Corp., 101 Park Ave., New York, N. Y.

Maj. George L. Shearer, Ord. Res.,
45 Wall St., New York, N. Y.

Capt. Harry W. Byington, Ord. Res.,
Ordnance Department, Camp Custer, Mich.

Capt. Helmer W. Christensen, Ord Res.,
Llewellyn Iron Works, Los Angeles, Calif.

Capt. Joseph W. Criglar, Ord. Res.,
1165 Bay St., San Francisco, Calif.

Capt. Raymond O. Eliason, Ord. Res.,
5507 13th St., N. W., Washington, D. C.

Capt. Harold W. Evans, Ord. Res.,
1112 35th St., Rock Island, Ill.

Capt. John J. Gordon, Jr., Ord. Res.,
502 20th St., Rock Island, Ill.

Capt. Raymond J. Hannon, Ord. Res.,
46 So. Lake St., Troy, N. Y.

Capt. John O. Kammerman, Ord. Res.,
714 Fourth St., Rapid City, S. D.

Capt. Harry R. Marshall, Ord. Res.,
16 Chesley Road, Newton Centre, Mass.

Capt. Francis P. O'Hara, Ord. Res.,
28 McCosh Road, Upper Montclair, N. J.

Capt. Robert S. Owens, Ord. Res.,
289 Clinton Ave., Brookland, N. Y.

Capt. Paul J. Roberts, Ord. Res.,
c/o Adjutant General's Office, Camp Lewis, Wash.

Capt. George T. Tomasky, Ord. Res.,
P. O. Box 253, Aberdeen, Md.

Capt. Joseph C. Tribby, Ord. Res.,
3115 M St., N. W., Washington, D. C.

Capt. Victor Wichum, Ord. Res.,
1291 Dean St., Brooklyn, N. Y.

1st Lt. Louis B. Armbrecht, Ord. Res.,
411 So. Penn St., Wheeling, W. Va.

1st Lt. Paul V. Engstrom, Ord. Res.,
425 Linden Ave., Albion, Mich.

1st Lt. Joseph E. Finn, Ord. Res.,
3660 Pio Pico St., Point Loma, Calif.

1st Lt. William B. Franke, Ord. Res.,
84 Exchange St., Rochester, N. Y.

1st Lt. Samuel Frankel, Ord. Res.,
223 Beach 121st St., Rockaway Park, L. I., N. Y.

1st Lt. Norman C. Hepburn, Ord. Res.,
1610 Webster St., N. W., Washington, D. C.

1st Lt. Charles Hiller, Jr., Ord. Res.,
1511½ 3rd Ave., Rock Island, Ill.

1st Lt. Bernard Mallon, Ord. Res.,
3832 Avenue "E" So., Birmingham, Ala.

1st Lt. James W. Saffold, Ord. Res.,
1841 Ea. 89th St., Cleveland, Ohio.

2nd Lt. Robert M. Allman, Ord. Res.,
Y. M. C. A., Dallas, Tex.

2nd Lt. Arthur B. Arnold, Ord. Res.,
2117 University Ave., Madison, Wis.

2nd Lt. Luther E. Blazier, Ord. Res.,
R. R. No. 2, Washington, N. J.

2nd Lt. Alexander C. Brown, Ord. Res.,
1048 E. Fourth St., Vinton, Ia.

2nd Lt. William A. Brown, Ord. Res.,
49 Baylay Ave., Yonkers, N. Y.

2nd Lt. Wayne L. Cockrell, Ord. Res.,
Research Dept., Midvale Co., Nicetown, Philadelphia, Pa.

2nd Lt. Morris C. Dobrow, Ord. Res.,
65 State St., Springfield, Mass.

2nd Lt. George F. Doughty, Ord. Res.,
1328 Broadway, New York, N. Y.

2nd Lt. Edward S. Flammger, Ord. Res.,
515 W. 3rd St., Joplin, Mo.

2nd Lt. Frank T. Francis, Ord. Res.,
1677 Ea. 93rd St., Cleveland, Ohio.

2nd Lt. Hugh C. Gilgan, Ord. Res.,
3 Bartlett St., Avon, Mass.

2nd Lt. Frank S. Hutter, Ord. Res.,
9 West Cantonment, Presidio of San Francisco, Calif.

2nd Lt. Lloyd W. Irving, Ord. Res.,
239 Howard St., Brockton, Mass.

2nd Lt. Herbert D. Knoop, Ord. Res.,
950 E. McMillan St., Cincinnati, Ohio.

2nd Lt. Alton W. Laird, Ord. Res.,
54 Dininny Place, Elmira, N. Y.

2nd Lt. Arthur W. Lee, Ord. Res.,
140 W. 73rd St., New York, N. Y.

2nd Lt. Elbridge H. Linton, Ord. Res.,
18 Dickens St., Boston, Mass.

2nd Lt. Robert D. Martin, Ord. Res.,
155 Brixton Road, Garden City, L. I., N. Y.

2nd Lt. Donald Morris, Ord. Res.,
2503 Auburn Ave., Cincinnati, Ohio.

2nd Lt. Wallace Murray, Ord. Res.,
937 28th Ave., Seattle, Wash.

2nd Lt. Howard M. Newton, Ord Res.,
86 Westwood Road, New Haven, Conn.

2nd Lt. Francis E. O'Callaghan, Ord. Res.,
Orienta Point, Mamaroneck, N. Y.

2nd Lt. Harold A. O'Callaghan, Ord. Res.,
Orienta Point, Mamaroneck, N. Y.

2nd Lt. Ello E. Richardson, Ord. Res.,
29 Tenth Ave., Haverhill, Mass.

2nd Lt. Leslie C. Ricketts, Ord. Res.,
808 Marquette Ave., So., Milwaukee, Wis.

2nd Lt. Robert J. Roland, Ord. Res.,
416 No. 15th St., Richmond, Ind.

2nd Lt. Henry N. Sachs, Ord. Res.,
114 Ea. 52nd St., New York, N. Y.

2nd Lt. William T. Shoemaker, Ord. Res.,
45 West Phil-Ellena St., Philadelphia, Pa.

2nd Lt. Edmund G. Shower, Ord. Res.,
West Annapolis, Md.

2nd Lt. Arvil C. Sigmon, Ord. Res.,
2509 Auburn Ave., Cincinnati, Ohio.
2nd Lt. Jerome B. Stern, Ord. Res.,
187 Butler Ave., Buffalo, N. Y.
2nd Lt. Claude M. Stroup, Ord. Res.,
1022 So. 51st St., Philadelphia, Pa.
2nd Lt. Ernest T. Wahlbom, Ord. Res.,
1232 Charles St., Rockford, Ill.
2nd Lt. Robert A. Wallace, Ord. Res.,
81 Pomona Ave., Newark, N. J.
2nd Lt. Charles R. Webb, Ord. Res.,
111 So. Lakeview Ave., Sturgis, Mich.

Recently Assigned Ordnance Reserve Officers

THE following reserve officers have recently been assigned as indicated after their names:

Lieut. Col. Charles W. Nunan, Ord. Res., Territorial Assignment Group.

Major Joseph S. Bates, Ord. Res., Manufacturing Service, Picatinny Arsenal, Dover, N. J.

Major Harry P. Caswell, Ord. Res., Manufacturing Service, Chicago Dist. Ord. Office, Chicago, Ill.

Major Beveridge C. Dunlop, Ord. Res., Manufacturing Service, New York D. O. O., New York, N. Y.

Major William R. Ham, Ord. Res., Manufacturing Service, Cincinnati D. O. O., Cincinnati, Ohio.

Major Jep C. Hardigg, Ord. Res., Manufacturing Service, New York D. O. O., New York, N. Y.

Major George L. Shearer, Ord. Res., Manufacturing Service, New York D. O. O., New York, N. Y.

Capt. Harry W. Byington, Ord. Res., Territorial Assignment Group.

Capt. Helmer W. Christensen, Ord. Res., Manufacturing Service, San Francisco D. O. O., San Francisco, Cal.

Capt. Hugh E. Coleman, Ord. Res., Field Service, San Antonio Arsenal, San Antonio, Tex.

Capt. Joseph W. Criglar, Ord. Res., Manufacturing Service, San Francisco D. O. O., San Francisco, Cal.

Capt. Raymond O. Eliason, Ord. Res., Manufacturing Service, Tank, Tractor and Trailer Division, Washington, D. C.

Capt. Harold W. Evans, Ord. Res., Manufacturing Service, Rock Island Arsenal, Rock Island, Ill.

Capt. John J. Gordon, Jr., Ord. Res., Manufacturing Service, Rock Island Arsenal, Rock Island, Ill.

Capt. Raymond J. Hannon, Ord. Res., Manufacturing Service, Buffalo D. O. O., Watervliet Arsenal, Watervliet, N. Y.

Capt. John O. Kammerman, Ord. Res., Manufacturing Service, Chicago D. O. O., Chicago, Ill.

Capt. Harry J. McIntyre, Ord. Res., Manufacturing Service, San Francisco D. O. O., San Francisco, Cal.

Capt. Harry R. Marshall, Ord. Res., Territorial Assignment Group.

Capt. Francis P. O'Hara, Ord. Res., Manufacturing Service, New York D. O. O., New York, N. Y.

Capt. Robert S. Owens, Ord. Res., Manufacturing Service, New York D. O. O., New York, N. Y.

Capt. Paul J. Roberts, Ord. Res., Territorial Assignment Group.

Capt. George A. Sherron, Ord. Res., Manufacturing Service, Philadelphia D. O. O., Philadelphia, Pa.

Capt. Joseph C. Tribby, Ord. Res., Manufacturing Service, Frankford Arsenal, Philadelphia, Pa.

Capt. Victor Wichum, Ord. Res., Manufacturing Service, New York D. O. O., New York, N. Y.

1st Lieut. Paul V. Engstrom, Ord. Res., Territorial Assignment Group.

1st Lieut. Joseph E. Finn, Ord. Res., Territorial Assignment Group.

1st Lieut. Samuel Frankel, Ord. Res., Manufacturing Service, Watertown Arsenal, Watertown, Mass.

1st Lieut. Norman C. Hepburn, Ord. Res., Manufacturing Service, Baltimore D. O. O., Baltimore, Md.

1st Lieut. Charles Hiller, Jr., Ord. Res., Manufacturing Service, Rock Island Arsenal, Rock Island, Ill.

1st Lieut. Marcel E. Juilly, Ord. Res., Manufacturing Service, San Francisco D. O. O., San Francisco, Cal.

1st Lieut. Kenneth S. Keyes, Ord. Res., Manufacturing Service, Birmingham D. O. O., Birmingham, Ala.

1st Lieut. Bernard Mallon, Ord. Res., Manufacturing Service, Birmingham D. O. O., Birmingham, Ala.

1st Lieut. James W. Saffold, Ord. Res., Technical Staff, Aberdeen Proving Ground, Md.

2nd Lieut. James H. Aiken, Ord. Res., Territorial Assignment Group.

2nd Lieut. Angelo J. Alama, Ord. Res., Manufacturing Service, Buffalo D. O. O., Watervliet Arsenal, Watervliet, N. Y.

2nd Lieut. Robert M. Allman, Ord. Res., Territorial Assignment Group.

2nd Lieut. Erling A. Arentz, Ord. Res., Manufacturing Service, Chicago D. O. O., Chicago, Ill.

2nd Lieut. Arthur B. Arnold, Ord. Res., Manufacturing Service, Chicago D. O. O., Chicago, Ill.

2nd Lieut. Willard C. Asbury, Ord. Res., Manufacturing Service, Picatinny Arsenal, Dover, N. J.

2nd Lieut. Robert C. Ashworth, Jr., Ord. Res., Manufacturing Service, Boston D. O. O., Boston, Mass.

2nd Lieut. William B. Bader, Ord. Res., Manufacturing Service, Picatinny Arsenal, Dover, N. J.

2nd Lieut. Paul L. Bartow, Ord. Res., Manufacturing Service, Birmingham D. O. O., Birmingham, Ala.

2nd Lieut. Levi T. Bellah, Ord. Res., Territorial Assignment Group.

2nd Lieut. Lee C. Bennett, Ord. Res., Manufacturing Service, Buffalo D. O. O., Watervliet Arsenal, N. Y.

2nd Lieut. Harold Bishko, Ord. Res., Manufacturing Service, Picatinny Arsenal, Dover, N. J.

2nd Lieut. Luther E. Blazier, Ord. Res., Territorial Assignment Group.

2nd Lieut. Edward L. Booth, Ord. Res., Manufacturing Service, New York D. O. O., New York, N. Y.

2nd Lieut. Thomas D. Boyd, Ord. Res., Territorial Assignment Group.

2nd Lieut. Alexander C. Brown, Ord. Res., Territorial Assignment Group.

2nd Lieut. William A. Brown, Ord. Res., Territorial Assignment Group.

2nd Lieut. Harold M. Catlin, Ord. Res., Manufacturing Service, Philadelphia D. O. O., Philadelphia, Pa.

2nd Lieut. Benjamin E. Chandler, Ord. Res., Manufacturing Service, Birmingham D. O. O., Birmingham, Ala.

2nd Lieut. Wayne L. Cockrell, Ord. Res., Manufacturing Service, Philadelphia D. O. O., Philadelphia, Pa.

2nd Lieut. Lloyd Colston, Ord. Res., Manufacturing Service, Buffalo D. O. O., Watervliet Arsenal, Watervliet, N. Y.
2nd Lieut. Ralph L. Coryell, Ord. Res., Manufacturing Service, Detroit D. O. O., Detroit, Mich.
2nd Lieut. Morris C. Dobrow, Ord. Res., Manufacturing Service, Bridgeport D. O. O., Springfield, Mass.
2nd Lieut. George F. Doughty, Ord. Res., Territorial Assignment Group.
2nd Lieut. Ralph L. Dunckel, Ord. Res., Manufacturing Service, Philadelphia D. O. O., Philadelphia, Pa.
2nd Lieut. George M. Ehlers, Ord. Res., Manufacturing Service, Chicago D. O. O., Chicago, Ill.
2nd Lieut. Edward S. Flammger, Ord. Res., Territorial Assignment Group.
2nd Lieut. Frank T. Francis, Ord. Res., Manufacturing Service, Cleveland D. O. O.
2nd Lieut. Rudolph A. Froehlig, Ord. Res., Manufacturing Service, Chicago D. O. O., Chicago, Ill.
2nd Lieut. George H. Fuller, Ord. Res., Manufacturing Service, Picatinny Arsenal, Dover, N. J.
2nd Lieut. Louis E. Gates, Ord. Res., Manufacturing Service, U. S. Nitrate Plant, Muscle Shoals, Ala.
2nd Lieut. Charles E. Geisler, Ord. Res., Manufacturing Service, Boston D. O. O., Boston, Mass.
2nd Lieut. Henry A. Gerken, Ord. Res., Manufacturing Service, New York D. O. O., New York, N. Y.
2nd Lieut. Hugh C. Gilgan, Ord. Res., Manufacturing Service, Boston D. O. O., Boston, Mass.
2nd Lieut. Walter B. Greeves, Jr., Ord. Res., Territorial Assignment Group.
2nd Lieut. Leon J. Griffey, Ord. Res., Manufacturing Service, Chicago D. O. O., Chicago, Ill.
2nd Lieut. Thomas A. Hayes, Ord. Res., Manufacturing Service, Boston D. O. O., Boston, Mass.
2nd Lieut. Walter H. Hickey, Ord. Res., Manufacturing Service, Boston D. O. O., Boston, Mass.
2nd Lieut. Spencer G. Hilliard, Ord. Res., Manufacturing Service Chicago, D. O. O., Chicago, Ill.
2nd Lieut. Frank S. Hutter, Ord. Res., Territorial Assignment Group.
2nd Lieut. Lloyd W. Irving, Ord. Res., Manufacturing Service, Boston D. O. O., Boston, Mass.
2nd Lieut. Joseph O. Jeffrey, Ord. Res., Manufacturing Service, New York D. O. O., New York, N. Y.
2nd Lieut. Stephen C. Jones, Jr., Ord. Res., Manufacturing Service, Birmingham D. O. O., Birmingham, Ala.
2nd Lieut. Gay P. Keith, Ord. Res., Manufacturing Service, Birmingham D. O. O., Birmingham, Ala.
2nd Lieut. Harold E. Kortman, Ord. Res., Manufacturing Service, Detroit D. O. O., Detroit, Mich.
2nd Lieut. Edward H. Lang, Ord. Res., Manufacturing Service, New York D. O. O., New York, N. Y.
2nd Lieut. Antonio A. Larria, Ord. Res., Manufacturing Service, Boston D. O. O., Boston, Mass.
2nd Lieut. Arthur W. Lee, Ord. Res., Manufacturing Service, Watervliet Arsenal, Watervliet, N. Y.
2nd Lieut. Elbridge H. Linton, Ord. Res., Territorial Assignment Group.
2nd Lieut. Raymond E. Lucey, Ord. Res., Manufacturing Service, Chicago D. O. O., Chicago, Ill.
2nd Lieut. Nevin H. McKay, Ord. Res., Manufacturing Service, New York D. O. O., New York, N. Y.
2nd Lieut. Robert D. Martin, Ord. Res., Territorial Assignment Group.
2nd Lieut. George E. Mason, Ord. Res., Manufacturing Service, Boston D. O. O., Boston, Mass.
2nd Lieut. Robert P. Mason, Ord. Res., Manufacturing Service, Boston D. O. O., Boston, Mass.
2nd Lieut. Robert H. Morrison, Ord. Res., Field Service, Savanna Ord. Res. Depot, Savanna, Ill.
2nd Lieut. Hamnett P. Munger, Ord. Res., Manufacturing Service, U. S. Nitrate Plant, Muscle Shoals, Ala.
2nd Lieut. Wallace Murray, Ord. Res., Territorial Assignment Group.
2nd Lieut. Alfred W. Nagel, Ord. Res., Manufacturing Service, Birmingham D. O. O., Birmingham, Ala.
2nd Lieut. Howard M. Newton, Ord. Res., Manufacturing Service, Bridgeport D. O. O., Springfield, Mass.
2nd Lieut. Francis E. O'Callaghan, Ord. Res., Territorial Assignment Group.
2nd Lieut. Harold A. O'Callaghan, Ord. Res., Territorial Assignment Group.
2nd Lieut. Harold V. Oerting, Ord. Res., Territorial Assignment Group.
2nd Lieut. Joseph P. O'Hern, Ord. Res., Manufacturing Service, Chicago D. O. O., Chicago, Ill.
2nd Lieut. Patrick C. O'Shee, Ord. Res., Manufacturing Service, Birmingham D. O. O., Birmingham, Ala.
2nd Lieut. William H. Palm, Ord. Res., Manufacturing Service, Philadelphia D. O. O., Philadelphia, Pa.
2nd Lieut. George E. Pierson, Ord. Res., Manufacturing Service, New York D. O. O., New York, N. Y.
2nd Lieut. William R. Potts, Ord. Res., Territorial Assignment Group.
2nd Lieut. Matthew M. Prewitt, Ord. Res., Manufacturing Service, Birmingham D. O. O., Birmingham, Ala.
2nd Lieut. Glendale M. Price, Ord. Res., Manufacturing Service, Buffalo D. O. O., Watervliet Arsenal, N. Y.
2nd Lieut. Walter J. Rhodes, Jr., Ord. Res., Tech. Staff, Aberdeen Proving Ground, Md.
2nd Lieut. Ello E. Richardson, Ord. Res., Territorial Assignment Group.
2nd Lieut. William M. Richtmann, Ord. Res., Manufacturing Service, Chicago D. O. O., Chicago, Ill.
2nd Lieut. Leslie C. Ricketts, Ord. Res., Manufacturing Service, Chicago D. O. O., Chicago, Ill.
2nd Lieut. George H. Ross, Ord. Res., Manufacturing Service, Chicago D. O. O., Chicago, Ill.
2nd Lieut. Henry N. Sachs, Ord. Res., Territorial Assignment Group.
2nd Lieut. John P. Sharkey, Ord. Res., Territorial Assignment Group.
2nd Lieut. Benjamin M. Shaub, Ord. Res., Manufacturing Service, Philadelphia D. O. O., Philadelphia, Pa.
2nd Lieut. William T. Shoemaker, Ord. Res., Manufacturing Service, Philadelphia D. O. O., Philadelphia, Pa.
2nd Lieut. Edmund G. Shower, Ord. Res., Manufacturing Service, Baltimore D. O. O., Baltimore, Md.
2nd Lieut. Earl W. Shriber, Ord. Res., Manufacturing Service, San Francisco D. O. O., San Francisco, Cal.
2nd Lieut. Arvil C. Sigmon, Ord. Res., Territorial Assignment Group.

Professional Notes

ARTILLERY AMMUNITION

Evolution of Wrapped Powder Charges

THE limited amount of separate loading ammunition required by the American Army before the World War introduction of the 155-mm. and higher caliber guns into the armament of the field armies had been provided by

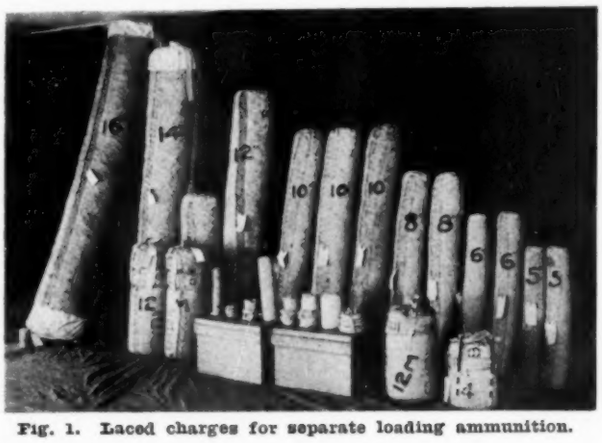


Fig. 1. Laced charges for separate loading ammunition.

the Government arsenals at Picatinny and Benicia. Cartridge bag design and loading methods were not highly developed. The bags were made of silk cartridge cloth filled with the proper weight of smokeless powder and given stiffness and shape by tightening the lacings on one

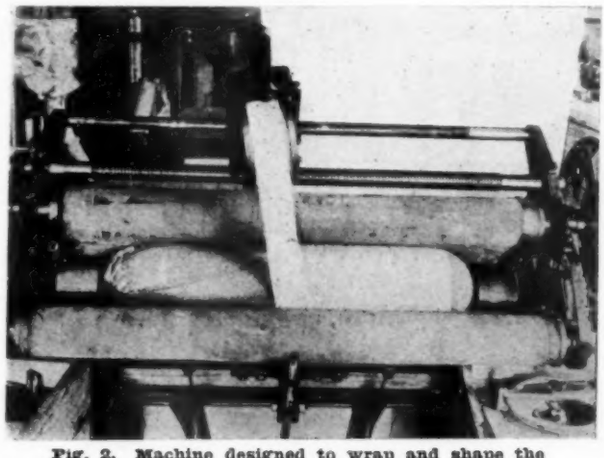


Fig. 2. Machine designed to wrap and shape the propelling charge.

or both sides, depending upon the size of the bag. The design can be best called a corset design, since the corset principle was used. This required the use of heavy cloth and stout lacings. Experienced operators could load and lace a charge in about thirty minutes. The only mechanical aids used in the manufacture of charges were cutting machines, sewing machines, scales and funnels. As soon as the World War requirements began to register it was apparent to those responsible for ammunition design that material changes were necessary. The great quantities of bags to be manufactured and filled called for the use of lighter weights of cloth and the introduction of assembling machinery.

Intensive study of the operations in the experimental plant at Picatinny Arsenal did not lead immediately to a solution of the problem. In fact, the situation looked hopeless. No one had ever made or thought of making a

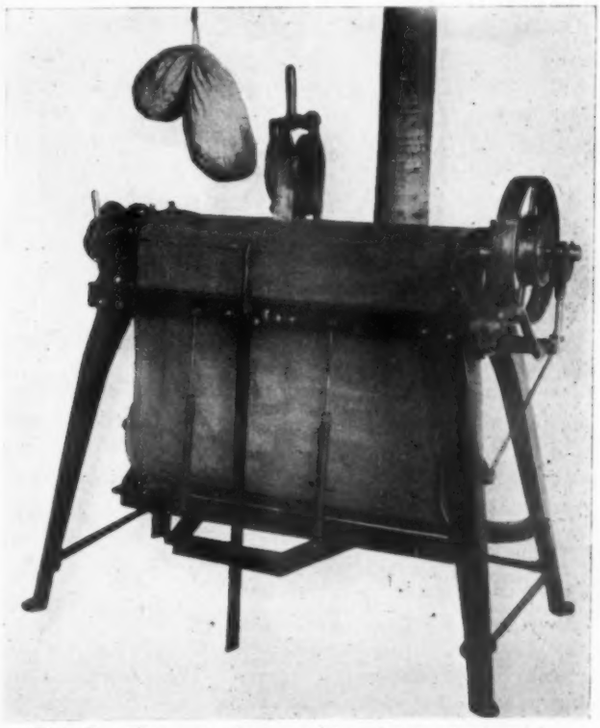


Fig. 3. The wrapping machine (rear view) with charge ready for operation.

machine to tighten the lacings of corsets. Something had to be done. Then, as always an inspiration came; in this case from seeing a man in uniform on crutches with his right leg bandaged to a splint. Why not apply the principle of a bandage to the powder charges? It was tried. It worked and, by hand operation, a bandaged charge could be assembled in half the time required for the laced type. Cloth of less strength could be used for the body of the bag; no lacing twine was required, and the resulting charge was superior to its predecessor.

The next step in the solution of the problem was to design and produce a machine to perform the operation of shaping and wrapping the charge. This required me-

chanical skill and was eventually found in a shop at Anderson, Indiana, where the first wrapping machine was designed, quickly manufactured and shipped to the Aberdeen Proving Ground for test. The official test showed that the time required to assemble a charge had been reduced from thirty to less than two minutes. Needless to say, the wrapping machine idea was accepted along with the wrapped type of charge. The design of charge became standard, equipment was installed in the World War loading plants, with the result that the majority of stocks of ammunition provided for use in the World War and on hand today are wrapped charges.

MAJ. J. H. MYERS.

WATERVLIET ARSENAL

Automatic Feeds for Antiaircraft Guns

AUTOMATIC feeds are used in small caliber guns to increase the rate of fire. One would naturally think then that any gun firing fixed ammunition could be fired faster if an automatic feed were used. It appears that the 3-inch 15-pounder antiaircraft gun is an exception to this general rule, for an expert gun crew loading by hand can fire one of these guns at a rate of 30 shots a minute. This is the maximum possible rate of fire of these guns. In this case the advantage of an automatic feed does not lie in an increased rate of fire but in a sustained rate of maximum fire. It would not be practicable for any gun crew to maintain a speed of 30 rounds per minute for any long period.

The field of antiaircraft guns varies in caliber from 37-mm. to 105-mm. The present 37-mm. antiaircraft ammunition weighs slightly over two pounds; the 3-inch ammunition weighs around thirty pounds and the 105-mm. ammunition weighs over eighty pounds. In guns of small caliber, not to exceed 2 inches, the feeding difficulty is not so great, because a hopper or clip carrying several rounds can be loaded and fired without any additional handling. In guns of larger caliber the fuzes have to be set for each individual round which means that each round has to be loaded in the tray or carrier separately.

The most practical advantage of automatic feeding is the ease with which high elevation firing can be accomplished. To have the gun mounted on a pedestal or carriage that is high enough to permit easy loading at 85° elevation would introduce a greater disadvantage when it is desired to fire the same gun at about 30° elevation; for at only 30° elevation the breech end of the gun would be too high to reach easily. Ordinarily at 85° elevation the breech of the gun is quite near the ground and the gun crew finds it quite hard to load and ram the shell home.

With automatic feeding the effort of raming the round home is done by energy stored up in springs either during the recoil or counter-recoil stroke. It then means that to secure a higher rate of fire the gun crew is only concerned in getting the proper round into the feed tray or carrier. In a design of a new type gun of large caliber in which automatic feeding is to be tried out, it is intended to let the feed tray recoil and counter-recoil with the gun. This means that the gun crew cannot start loading the round into the tray until the recoil and counter-recoil strokes have been completed. This would seem to be an unnecessary delay in starting the feed operation. But even with this delay it is anticipated that with the time saved in eliminating the raming operation the speed can be materially increased. Ordinarily the feed tray or carrier is fixed to a non-recoiling member. This permits loading the second round into the tray as soon as the empty tray has returned to its position; this may be even before the first round has been fired.

Automatic feeds are best applied to antiaircraft guns where the maximum rate of fire is necessary. It is quite possible that not only must the maximum rate of fire be obtained but that it must be maintained over a period of several minutes. By merely eliminating the effort of raming the rounds into the chamber the work required of the gun crew will be greatly reduced and a consequent increase in rate of fire obtained. In some types of antiaircraft guns the complete round weighs over 80 pounds and to load, for a long period, a gun firing ammunition as heavy as this would be too great an exertion for any crew. While automatic feeds for antiaircraft guns are comparatively new devices their usefulness has already been demonstrated. The period of time in which the air target is within range is limited and for this reason it is most desirable to deliver the maximum volume of fire during this time. This maximum volume of fire can be delivered from a large battery of guns manned by separate crews or by a smaller battery of guns equipped with automatic feeds and probably manned by even a smaller gun crew.

A. H. SKINNER,
Capt., Ord. Dept., U. S. A.

SMALL ARMS

Meeting of Ammunition Board

A MEETING of the Ammunition Board appointed each year by the Secretary of War for the purpose of determining the type of arms and ammunition to be used in the National and International matches, and make necessary tests for the selection of these arms and ammunition, was held in the office of the Chief of Ordnance, Washington, D. C., October 21st. The following members of the Board was present:

Brig. Gen. Colden L'H. Ruggles, Assistant Chief of Ordnance and Chairman of the Board; Col. Alexander J. MacNab, Jr., Infantry; Lt. Col. George C. Shaw, Infantry and Director of Civilian Marksmanship; Lt. Comm. Eugene E. Wilson, United States Navy; Maj. R. S. Keyser, United States Marine Corps; Maj. Clair W. Baird, Coast Artillery Corps; Maj. Herbert O'Leary, Ordnance Department; Maj. Francis W. Parker, Jr., Ordnance Reserve Corps; Maj. L. W. T. Waller, Jr., Marine Corps Reserve; Capt. Grosvenor L. Wotkyns, Ordnance Department; Capt. Harry L. Marshall, Ordnance Department, Massachusetts National Guard; Mr. K. K. V. Casey, E. I. Dupont de Nemours and Company, Wilmington, Del.

As has been the custom, this meeting was attended by representatives of all the larger cartridge loading companies and powder manufacturers. Among these representatives were Mr. J. S. Gravely and Mr. Davis, of the Winchester Repeating Arms Company; Colonel Tewes and Mr. Starkweather, of the Peters Cartridge Company;

Mr. R. F. Riggs, Western Cartridge Company; Mr. F. J. Kahrs, Remington Arms Company, Inc.; Mr. Gerald Cahill, U. S. Cartridge Company; Mr. H. N. Marsh and Mr. L. C. Weldin, of the Hercules Powder Company; Col. H. W. Schull, Commanding Officer, Springfield Armory; Col. Odus C. Horney, Commanding Officer, Frankford Arsenal; Maj. Townsend Whelen, Ordnance Department; and Maj. J. S. Hatcher, Ordnance Department.

In view of the satisfactory reports received at the 1925 National matches, no changes were made in the specifications of the arms and ammunition to be used in the National, International and Palma match competitions. The Board set April 6, 1926, for the date of test and selection of ammunition for the International and Palma matches, to be held at Aberdeen Proving Ground. These tests are conducted annually and are participated in by several cartridge loading companies and Frankford Arsenal. The interest taken in these tests by the loading companies is a source of much gratification to the Ordnance Department. The expense incurred by the companies in experimental work in preparation for these tests is not offset by the small manufacturing orders which are placed with the winner of the test, and it is more of a patriotic sacrifice on the part of these companies to furnish United States teams with the best possible ammunition that can be manufactured in the United States, and to keep alive the art of manufacturing military ammunition.

Among many of the interesting points discussed was the question whether the Board should specify that all ammunition entered in the tests should be machine loaded. This idea was suggested with a view that it would further the art of machine loading and thereby conform to our Industrial Preparedness plans, and it was the view of several that the art of machine loading could be so perfected as to make it superior as to accuracy to hand-loaded ammunition. After considerable discussion the Board decided that no effort should be spared to supply our teams with the best possible ammunition. No restrictions therefore were placed on the method of loading ammunition for these tests.

Another topic considered came from one of the members that the Board to encourage the reorganization of the American Society of Ammunition Manufacturers of Small Arms and Ammunition. One of the main purposes of this Society was to standardize manufacturing practices particularly with reference to chamber and cartridge dimensions. After considerable discussion as an initial step in this direction the Board passed a resolution recommending the organization of an advisory committee of manufacturers of small arms ammunition for the purpose of meeting with the Ordnance Department and discussing matters of standardization and improvements.

A slight change was made in the firing program for the determination of the winner of the 300-meter International match ammuntion tests. Heretofore, the winner of this test has been decided by the so-called "Figure of Merit" system which is the means of the extreme verticals and extreme horizontals of the targets. The winning ammunition will now be determined by the "mean radius" system which is used for all other ranges. Heretofore, it was thought that in view of the small targets obtained at 300 meters with super-accurate ammunition, it would be impossible to determine the mean radius of so small a group. However, after the extensive study of a large quantity of International match test targets by the Ordnance Department, it was found that the mean radius could be accurately determined from targets having such small groups as are made at this short range.

The Ordnance representative informed the Board that as the 1925 caliber .30 National Match Cartridge had been adopted as the new service ammunition it was very llikely by another year funds would be available for manufacturing some of the new type of ammunition to replace the depleting war stocks. In case the funds are received a plan has been considered whereby orders, possibly to the extent of two million rounds, will be placed with each of the loading companies.

It is also believed that it may be possible to reward the winner of the ammunition tests by increasing the order to that company.

FRANK J. JERVEY.

Fedoroff Machine Gun

A RECENT number of a German military publication gives the following details of the light machine gun recently adopted for the Red Army, Russia.

This gun, called the Fedoroff after its inventor, weighs only five kilograms and has a calibre of 6.5-mm. It has a movable barrel and a breech consisting of two bolts, one on each side. The magazine holds 25 rounds. The ammunition is of Japanese manufacture, which is reported to have been found more suitable than that of Russian make for the gun.

The initial velocity is 680 meters and the rapidity of fire is 25 rounds per minute individual fire and from 75 to 100 rounds rapid fire. There is no provision for cooling the gun. (*Military Note furnished by The Military Intelligence Division, General Staff.*)

Portable Rifle Cleaning Plant

ONE of the biggest and most difficult problems confronting Ordnance personnel at a summer training camp is that of the care and preservation of Ordnance equipment. This work, according to regulations, is a function of the troops to whom the equipment is issued but it is a function of the Ordnance Department to see that the equipment is properly cared for. Where regular troops only are involved the problem can probably be met satisfactorily by camp regulations and disciplinary action where necessary on the part of camp authorities. However, in R. O. T. C. and C. M. T. camps the problem is quite different. These men have a very busy training schedule and besides have not yet learned to appreciate the necessity for constant care and attention to their equipment, especially their rifles. It is of course to the advantage of the Ordnance Department to have the rifles issued these men kept in a clean and serviceable condition at all times and every effort should be made to accomplish this. The wear and tear on the rifles is less, the number rendered unserviceable is reduced and the work of the Ordnance personnel in preparing the rifles for winter storage is considerably lessened. It is therefore one of the important duties of the camp ordnance officer to take such steps as are within his power to accomplish the desired results.

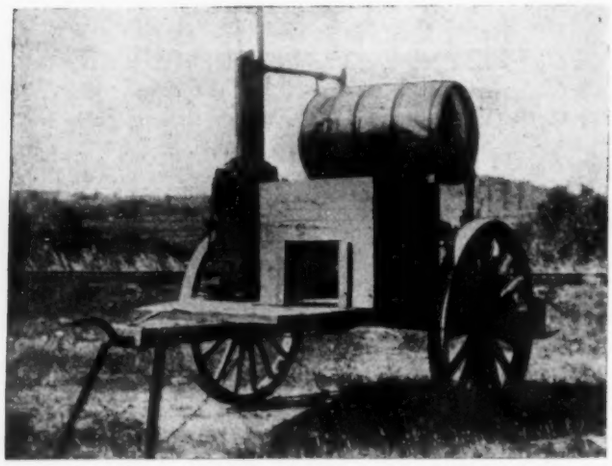


Fig. 1. Front end of the Cleaning Plant ready for use.

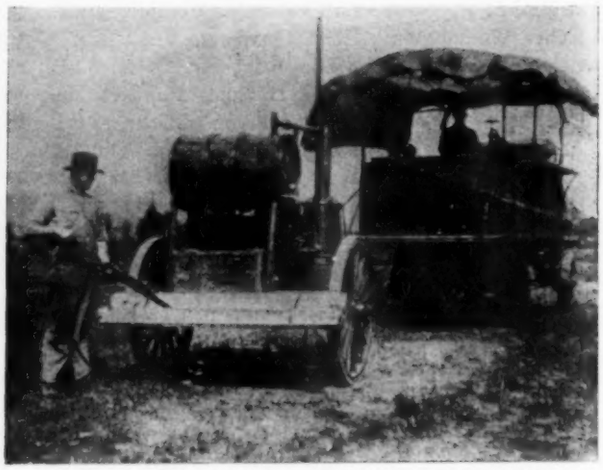


Fig. 2. Another view of the rifle-cleaning plant.

Of the different means open to camp ordnance officers to influence the amount of attention given to the care and preservation of rifles, the following seem to promise the best results: (1) Inspection: both that prescribed for company officers and those made by camp ordnance officer; (2) instructions in the proper methods of cleaning; (3) special means and equipment which can be provided by camp ordnance officer and made easily available to the troops.

The success of any or all of these methods depends very much upon the sympathetic coöperation and assistance of the camp commander and staff. Where such coöperation and assistance are available all three of the methods should be employed and even then the results may not be all that could be desired.

Camp McClellan, Alabama, during the past two or three training seasons, is an instance where the camp commander and his entire staff appreciated the importance and the necessity for constant attention to the rifle. During the training season just past the author of this article was camp ordnance officer of this camp and the support and assistance given him not only by the camp authorities but also by the R. O. T. C. and C. M. T. camp commander, was all that could be desired. There was included in camp regulations a provision that company officers would inspect all rifles issued their organizations a minimum of three times per week. Men whose rifles were found dirty at these inspections were requird to clean them at once. Special instructions for cleaning the rifle were drawn up by the Corps Area ordnance officer. These instructions were mimeographed and a copy posted on each organization bulletin board and in addition a copy was issued to each squad.

These regulations served to keep the rifles in good condition except when the troops were actually firing on the target range. The need for additional cleaning facilities had been recognized during previous camps and to meet this need the ordnance personnel during the winter months constructed a portable cleaning outfit. Since rifles can be most effectively cleaned immediately after firing, this outfit was designed to be taken to the range and made available during the entire times troops were firing. Its main purpose was to provide hot sal soda solution for swabbing out the bores of the rifles after firing. A small stock of cleaning patches, oils, etc., were carried with the outfit and an ordnance enlisted man was kept on duty with it at all times.

The organizations which used this plant during the past season were very enthusiastic over it and it is believed that by providing this means of giving prompt attention to the care of the rifles after firing, the number of rifles rendered unserviceable during the camp was very materially reduced.

In addition to keeping this plant on the range during target practice, it was found advantageous to send it to a convenient point after a maneuver in which blank ammunition was used.

Besides the practical results obtained, another very important object was accomplished. The feeling was created among the troops that the Ordnance Department was actually doing what it could to assist them in keeping ordnance equipment in serviceable condition. In other words, the efforts of the Ordnance personnel were appreciated and not a complaint was received during the camp on the service rendered.

In view of the success attending the use of this outfit it is thought that a brief description of its construction might be of interest to readers of ARMY ORDNANCE. Fig. 1 shows the front end of the plant set up ready for use, and in Fig. 2 is shown another view and also the manner in which it is attached to a truck for moving from place to place.

In the construction of this plant only such materials as are generally obtainable at any post or camp were used. The principal items are:

A pair of wheels and axle, a small water back stove, such as is used in camp bath houses, a fifty-gallon steel drum, a sheet metal cleaning trough, a safety valve, and odds and ends of piping and lumber.

The outfit shown was entirely constructed by ordnance enlisted men with the assistance of a civilian mechanic. It was found in operation that additional troughs and rifle supports were needed. These were made of sheet metal and attached at convenient places.

C. A. WALKER,
Maj., Ord. Dept., U. S. A.

Welding on Boilers

IN view of the ever-widening applications of fusion welding throughout industry and the probability that repairs to boilers made in this way will be proposed from time to time, it is well that those responsible for the results should

Ordnance Mobile Repair Shops in the exhibit at Erie Ordnance Reserve Depot.

bear several points in mind. For simplicity, these are listed briefly below:

1. Most boilers are insured.
2. Many boiler insurance policies are so worded that if repairs are made without the authority of the company carrying the insurance, the policy becomes void.
3. There are Federal, State and Municipal regulations governing this work, as well as those issued by the insurance companies.
4. Only competent welders, used to boiler work, should be allowed to do the welding.

Therefore, the following precautions should be observed by the owner or his representative:

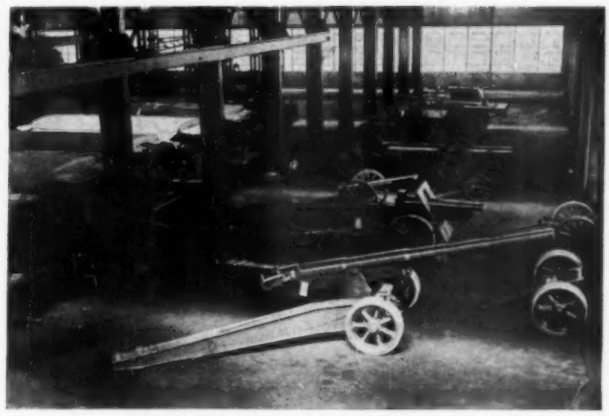
1. Examine the part of the boiler to be welded in company with the insurance company inspector, and get his approval before doing any welding.
2. Be present at the test after welding with the inspector.
3. If possible, get the inspector to sign a statement that the work has been properly done and that it has passed the test successfully.
4. If the boiler is not insured, and comes under Federal, State or Municipal supervision, carry out the above program in company with the proper authority.

If the boiler is neither insured nor under supervision of some constituted authority, ample precautions should be taken by the welder and the owner to protect themselves against possible future trouble. They should make a sketch of the location and size of the repair, with a clear statement of what was found wrong and how the repair was made. They should always make a hydrostatic hammer test of the finished job, using a pressure of one and one-half times the working boiler pressure, in the presence of witnesses, and get their signature to a statement of the facts. These papers should be carefully filed away. In such a case, no welding should be done which is not permitted by law or by good practice.

In case of marine work, the welder should pass the regular examination of the Federal Steamboat Inspection Service.

In all cases, the welder should make friends of the insurance and other inspectors by refusing to do work unless authorized by them, by being conservative in what work he recommends, and by doing nothing except a first-class job.

S. W. Miller,
Past President, American Welding Society.



Gun Exhibit at Erie Ordnance Reserve Depot.

Ordnance Exhibit at Erie Ordnance Reserve Depot

ERIE ORDNANCE RESERVE DEPOT, formerly Erie Proving Ground, is located on Lake Erie, seven miles from Port Clinton. It is a war-time establishment built for proof-firing guns and carriages but has since been converted into a storage depot for artillery material.

Adjacent to Erie Ordnance Reserve Depot is Camp Perry, where the National Rifle Matches have been held for the past few years. This year there were over four thousand people gathered at Camp Perry all with a keen interest in small arms. The matches not only drew representatives from our Service, National Guard, R. O. T. C. and C. M. T. C. teams but contingents from rifle clubs and individuals throughout the country. All were interested in the Ordnance Department because of their high regard for the Springfield Rifle and the satisfactory results secured from the Match ammunition.

Believing that this was an opportune time to emphasize the additional activities of the Ordnance Department, an exhibit of stores was held on September 11th. This exhibit contained an item of all classes of Ordnance, stored and maintained at Erie. It included 37-mm. and 75-mm. guns, 155-mm. How., 155-mm. GPF and 240-mm. Howitzers complete, and the artillery repair, small arms and HMORS trucks. These units were tagged, showing general data of interest as range, muzzle velocity, weight of projectile, approximate cost, etc. Several of the shops were put in service and were in operation during the exhibit. A bus schedule was established between the two posts and the exhibit was announced at Camp Perry.

This is only the beginning and in another year a larger and more interesting exhibit can be held, with increased attendance. It is hoped that those who attend the matches will always avail themselves of the opportunity to visit Erie Reserve Depot and inspect the interesting exhibit.

D. N. Hauseman,
1st. Lieut., Ord. Dept., U. S. A.

Carnegie Institution Exhibition

THE Annual Exhibition of the Carnegie Institution of Washington will be open to the public, at the Administration Building, 16th and P Streets, N. W., on December 12, 13 and 14, from 2 to 5:30 and from 7 to 10. On Monday evening, December 14, exhibits of special interest to physicists, chemists and engineers will be featured. Members of the Army Ordnance Association are invited to attend the exhibition.

Recent Patents

Brief Descriptions of Inventions of Interest to Ordnance Engineers

Compiled by W. N. Roach, Chief, Patent Section, Office of the Chief of Ordnance

AMONG the patents recently issued the following relating to ammunition are of particular interest:

Ammunition

Heinrich Jacob of Frieden, Germany, has been granted patent No. 1,547,219, for a projectile device. This invention relates to a bomb and mechanism for carrying and releasing the same, the release mechanism being so constructed that the bomb and its fuze are carried separately, the fuze being automatically assembled with the bomb when the latter is released.

George C. Hale and Fred Olsen of Picatinny Arsenal, have been granted patent No. 1,547,808, for propellant powder. This patent covers a propellant powder having as one of its ingredients pentaerythrite tetranitrate or nitroguanidine together with other ingredients or having both these ingredients either alone or with other ingredients.

The same patentees have also been granted patent No. 1,547,809, for a process for preparing propellant powders. This patent covers both the process which includes dissolving pentaerythrite tetranitrate with a solvent which acts as a colloiding agent for nitrocellulose and the propellant containing pentaerythrite tetranitrate and nitrocellulose.

Patent No. 1,547,815, has been granted to Dean N. Jackman and Fred Olsen of Picatinny Arsenal, for an explosive composition, which contains a nitro-aromatic derivative of guanidine.

Patent No. 1,547,869, has been granted to Charles R. Franklin of Picatinny Arsenal, for a propellant powder. This patent covers a powder containing nitrocellulose and nitroglycerine together with other ingredients specifically a nitrohydrocarbon and a hydrocellulose.

Fleming R. Weaver of Edgewood, Maryland, has been granted patent No. 1,548,693, for a firing mechanism for pyrotechnics. The mechanism disclosed in this patent consists of a match composition in communication with a pyrotechnic composition together with a rotatable plug normally held in safe position but rotatable to bring an abrasive into contact with the match composition causing the same to ignite.

Patent No. 1,549,763, for a fuze for projectiles, has been granted to Neville Greenwell, assignor to Bethlehem Steel Company. This patent covers a fuze of the delay action type so constructed that the firing element is retained in safe position until the projectile is retarded by striking a target when the safety means is unlocked but is still held to retain the firing element safe until the retardation of the shell ceases when the firing element is released to fire the fuze, thus insuring firing of the fuze after the same has penetrated the target.

Patent No. 1,550,064 has been granted to Jacob Ehrlich, assignor to Verona Chemical Company, for an explosive which consists of the mixture of 2 salts of organic aminosulphonic acid with an oxidizing compound.

George C. Hale and Fred Olsen of Picatinny Arsenal, have been granted patent No. 1,550,960, for a method for preparing propellant powder. The invention covered by this patent consists of a method of dissolving nitroguanidine in a solvent which is also a colloiding agent for nitrocellulose.

Wm. L. Lukens, assignor to Bethlehem Steel Company, has been granted patent No. 1,550,977 for fuze for projectiles. This patent covers the specific structure of fuze shown, one of the main features of which seems to be the provision of a rotary element which acts as a safety device in which element the time train is also carried.

William L. Lukens, assignor to Bethlehem Steel Company, has also been granted patent No. 1,550,978, for a fuze for projectiles. In this patent there is disclosed a fuze similar to the one shown in the patent above mentioned, but presenting specific differences in structure.

Nicholas E. Methlin, assignor to Schneider et Cie, has been granted patent No. 1,551,963, for a percussion fuze. This patent covers a fuze of the all ways striker type which is normally held in unarmed position but is armed by centrifugal force and then locked by the same force in armed position.

Frederick G. L. Johnson, assignor to Vickers Ltd., has been granted patent No. 1,552,435, for a high explosive shell. The main object of this invention appears to be the provision of a shell provided with a nose fuze but possessing the advantages of base fuze ignition. This object is accomplished by causing a booster at the base of the shell to be fired by the nose fuze, communication of detonation of the primer to the booster being had through a central tube in the shell. The patent covers the specific construction of the fuze shown.

John B. Fidlar and Chas. R. Franklin of Picatinny Arsenal, have been granted patent No. 1,552,601, for a propellant powder. This patent covers a propellant powder containing as essential ingredients nitrocellulose and hydrocellulose.

Artillery

THE following patents relating to artillery are of special interest:

Patent No. 1,549,847, has been granted to Capt. Charles S. Reed, Ord. Dept., U. S. A., for a gun. The invention

covered by the patent consists of a form of valve for venting the explosive chamber to control the range of the gun.

James B. Henderson of Lee, England, has been granted patent No. 1,553,077, for a sighting device. The main feature of the invention covered by this patent is the provision with an optical device of a reflector and gyroscopic means for controlling it. The device is of particular use on ships, aircraft and the like.

Patent No. 1,553,824 has been granted to Frederick C. Langenberg, assignor of one-half to Col. Tracy C. Dickson, Ord. Dept., U. S. A., both of Watertown Arsenal, for a method of and apparatus for making metallic articles. The invention covered by this patent consists essentially in increasing the elastic limit of a hollow metal article by subjecting it to pressure while restraining the article against movement beyond a predetermined amount in a temporary mold.

Dr. Langenberg, assignor of one-half to Colonel Dickson, has also been granted patent No. 1,553,825, for a method of making guns and other hollow metal articles. The invention covered by this patent consists essentially in forming a hollow article by first casting the metal, then annealing the casting, and then subjecting it to expanding pressure while inclosed in a container complementary in shape to the final shape of the article to be produced.

Patent No. 1,552,863 for a small caliber gun, has been granted to N. E. Methlin, assignor to Schneider et Cie. The invention covered by this patent consists of an endless conveyor operated by the alternate recoil and running out of the gun to remove ammunition from a magazine and convey such ammunition to a distributor which loads the ammunition into the gun.

Patent No. 1,552,864 for a gun for firing at ranges which may be varied between very wide limits, has been granted to N. E. Methlin, assignor to Schneider et Cie. The invention covered by this patent consists of a gun barrel, the cartridge chamber of which is made of a number of progressively reduced sections, the shoulders between the sections forming a stop for rotating bands of different sizes thus causing a reduction or increase in the size of the cartridge chamber.

Small Arms

THE following patents are worthy of note by those interested in small arms:

Patent No. 1,547,295 has been granted to Wm. R. Bull of Springfield Armory, for a machine gun tripod. The main object of this invention is the provision of a tripod with a cradle whereon the gun may be so mounted that the center of gravity of the gun is substantially coincident with a point in the axis of the trunnions of the cradle.

Chas. Suter, assignor to Societe Anonyme des Anciens Establissements Hotchkiss et Compagnie, has been granted patent No. 1,547,293, for a firing mechanism for automatic firearms. The invention covered by this patent consists essentially of a trigger, a sear, a sear lever connecting the trigger and sear, and a safety device acting upon the sear lever so as to effect either single shot firing or continuous firing, or to lock the members in safety position.

Fritz Zehner has been granted patent No. 1,548,236, for a self-loading pistol. This patent covers a specific structure of self-loading pistol which is such as to allow the pistol to be easily assembled and disassembled.

John M. Browning has been granted patent No. 1,548,708 for a recoil buffer for automatic guns. The invention covered by this patent is a specific form of buffer mechanism for automatic guns consisting of two contacting blocks, the contacting faces of the block being inclined, one block acting along a line parallel to the longitudinal axis of the gun and the other block acting at right angles thereto.

The same inventor has also been granted patent No. 1,547,709, for a magazine firearm. This patent covers a specific form of casing provided with a magazine opening.

Bedrich Schreiber, assignor to Zbrojovka Praga Spol. SR. O., has been granted patent No. 1,549,051 for a light machine gun. The invention covered by this patent consists of the provision of connecting means for the barrel of a light machine gun such that the barrel may be quickly removed and replaced by a cool barrel to avoid the necessity of cooling the former.

Patent No. 1,549,235, has been granted to Jose Valero, for a rifle bolt. The main object of this invention is the provision of a striker bar and firing pin so designed that the firing pin may be removed and replaced without disturbing the adjustment of other parts of the bolt.

Arthur T. Dawson, G. T. Buckham and Carl A. Larsson, assignors to Vickers Ltd., have been granted patent No. 1,550,787, for an articulated link for cartridge belts for machine guns. The invention covered by this patent consists of metallic links of that class in which the cartridge forms the connecting pivot pin between the links, the links being formed with projections thereon under which the feed pawl will engage so as to prevent slipping of the pawl in feeding the belt into a gun.

Christian Pohlman, assignor of one-half to Marberg Bros., Inc., has been granted patent No. 1,551,617 for machine or rapid fire guns and the like. The invention consists in a jacket for machine guns so constructed that the suction of the gases of discharge draws air through the jacket and thereby cools the gun.

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Book Reviews

Winged Defense. By Col. William Mitchell, U. S. A. New York: G. P. Putnam's Sons. 1925. $2.50.

IN the very midst of a violent controversy in which he is the central figure, General William Mitchell has produced his side of the case in two hundred and sixty-one pages of a book. He makes out a pretty good case for his side before he sums up his long line of argument. Whether he interprets rightly the evidence he has before him, one cannot say, certainly not in the face of so many and such opposite interpretations as have appeared from War and Navy Department sources in recent weeks, but this much is evident to his readers, viz.: that he has every confidence in his own interpretation.

He enjoys his writing. He may be slightly timid before a battery of notebooks and cameras or before a critical audience, but when he gets off by himself to write a book, he certainly throws off all embarrassment. He struts just as he likes through all the pages, gestures and boasts, hurls "absolutelys" and "positivelys" into the face of his audience and wears it to a frazzle. His excessive enthusiasm and lack of modesty tend to obscure his sincerity and his constructive criticism of present-day methods. He seems disloyal, though he is intensely patriotic. He tattle-tales when he means to be crusading for better defense. He rattles the saber of Caesar, Alexander and Napoleon in his implied desires to master the earth, though he merely desires to praise his own scheme for a great aviation service. He speaks too positively, too loudly, too one-sidedly to convince.

The Putman's have gotten out his book in an interesting way. They have filled the cover pages with Powers' cartoons, showing General Mitchell in various guises, as a danger alarm going off in a sleepy War Department, and have written a concise introductory statement to qualify their author as an expert witness on aviation. General Mitchell also adds a foreword to explain how few people know anything at all about aviation beside himself and his Air Service friends. He adds a preface to explain that he is arguing about the business of getting an Air Department in the executive branch of the Government. After these several preliminaries, the main arguments of Winged Defense begin to appear.

All that he has to say in his book has appeared in the daily press and the periodicals in the past year or two, but here, he gathers it together a little better. He has a chance to describe his scenery, the high atmosphere, a new world to many of us which we have ever seen above us but never known. He populates that world with a new class of people of different spirit, language and customs, the air going people as opposed to the land going and sea going classes. Their world is so much greater than that of the two latter classes, having another dimension and extending to the outer limits of the atmosphere over the whole surface of the globe regardless of climate, topography or government. In this world there is still room for conquest and much high adventure. He cites many examples in nearly all of which he has taken a prominent part. He shows himself up in that world in his pretty airplane over France and its battlefields, looking at the land-goers struggling for ground mastery. Enemies in his own world are met and destroyed. He is up in that world over the Atlantic and the Chesapeake, directing his bombers upon the great battleships which have been provided for him to destroy.

I fear he gloats a little too much over this, forgetting that his brother officers were even more anxious than himself to learn the exact possibilities and limitations of the problem, more careful to learn the exact truth in such a costly experiment for the future preparation of their country's defense. In his hilarious joy over his success and notoriety, he loses sight of the fact that he was merely a part of their experiment, a bomb carrier for their bombs to be burst for their benefit on their old battleships. He laughs at them from his high perch and chides them, draws them into a newspaper controversy and makes gruesome jokes over the bitter problems of defense, where there should be only calm and earnest deliberation and study. Like a naughty boy, he steals the prize, which they have helped to establish, carries it away as his private and personal property to boast about before the Congress and the people. He is unfair, unkind and unethical toward his profession in this great experiment, but he makes out of it a sad case for the battleship.

He is too prejudiced to write well about military things, but in his chapters on civil aviation he paints a better, more logical picture. The fine examples of the past few years afforded by the mail service, the forestry service, the great passenger services of Germany and England are given full meed of praise. Their successes lead him to offer in our lifetimes, that the spring and summer will be only a few hours from our door no matter how deeply the snow may be drifting about it, that the boundaries of nations will disappear, that the remotest peoples will read the morning paper at breakfast, and that the magic carpet of Bagdad will come out of fairyland into our everyday lives.

With all the possibilities of aviation for defense and for our daily uses when defense is not required, the National Government is asked to pay a little more attention to the coming aeronautical age, to look around at its neighbor nations just a few hours away now, and to note what they are doing about it, to get his most important guarantee of future safety and supremacy, the Air Service, from underneath the pressure of the old-fashioned, slow-going departments, to get a race horse out of truck harness and let it run. The necessary features, which will be required of his new department are described at length,

even to explaining all about the organization of the defense units, the planes, the fields, the hangars, the pilots, the mechanics and the leaders to be obtained. The various duties of air forces are classified and described, the relative costs and possibilities compared with old time Army and Navy defense are argued and decided. In all, one obtains an excellent idea of a possible plan for controlling the commerce and political progress of the world from one air nation. And, too, one learns much of the way in which we must go about the protection of our cities and institutions from an enemy in the air.

General Mitchell has much to say of the ineffectiveness of antiaircraft guns, and the greater efficiency of airplanes for all defense against aircraft attack. If he could have left his prejudices at home, he might have made a better case. What he says about the hitting possibilities may be nearly correct, as far as we now know, but there is a greater effectiveness from the long range "archie" than he cares to admit. There was a greater effect during the World War than he has admitted, especially in the defenses around Paris and about the munitions plants of Germany. And he fails to consider that antiaircraft has not had the money nor attention that have been given toward the development of the greater problem of conquering the air. Antiaircraft artillery has many limitations, but in its field, it must be fostered and developed to relieve the aircraft of the country from fixed duty for its more important missions out over the lanes of approach. It must not be sneered at because of its relatively lesser importance than the aircraft problem. General Mitchell knows this too well to speak so disparagingly. He does not mean all that he infers. I am surprised that he does not include it in his air department where it might be placed efficiently and conveniently.

As to his conclusions, one must reason from his evidence that they are sound and desirable from the standpoint of the most positive defense. Certainly aviation is an intensive and strenuous business requiring not only knowledge of the air and the airgoing machines but abundant enthusiasm and boundless daring as well. Its possibilities have thrilled the dreamers of all ages and they are carrying General Mitchell into visions which must seem fantastic and unreal to those who have plodded over the earth for so many years and expended their strength and ingenuity in overcoming its obstacles. One hesitates to prophesy. Progress has been so rapid that its plotted curve stretches rapidly toward the end of imagination. Enough of the future is evident to demand some immediate action to prepare for it. General Mitchell makes this plain throughout his book and sums it up at the end.

General Mitchell has added to his book the statement of the National Advisory Committee for Aeronautics which indicates the functions of the four services concerned with air matters in this country: The Army Air Service, the Naval Bureau of Aeronautics, the Air Mail Service and the National Advisory Committee. At the end, he has placed an excellent index to give his book additional value for reference purposes in our libraries. The intention is evident, that the book shall serve as a master reference on matters of aeronautics. Unfortunately, I cannot offer it such a high place. With all its good material, its interesting reading and its high thoughts, it is too close to the great controversy to be fair or impartial.

C. G. METTLER.

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The Riddle of the Rhine. By Victor Lefebure. New York: The Chemical Foundation, Inc. 1923.

THE riddle propounded by the author for solution concerns the menace offered by the great German I. G. (*Interessen Gemeinschaft*), the world monopoly in organic chemical enterprise. According to the author, who is well qualified to write upon the subject, this monopoly, which threatened to turn the tide of the war against the Allies, has been uncurbed and comes out of the war with increased power.

In order to prove the menace of this monopoly in organic chemistry, referred to as the I. G., the author gives a complete historical sketch of chemical warfare from its origin until the close of the World War. In this discussion the importance of the combined technical staff of the I. G. is placed on a par with that of the German General Staff and production facilities of this great chemical monopoly on a par with those of the great Krupp works.

In tracing the use of gas during the World War the author starts with the appearance of the first gas cloud with its resultant horrors on account of the entire absence of protective equipment for this type of warfare. There then follows step by step the introduction of protective measures in the way of masks, the development of new gases which would penetrate the type of mask in use and ultimately, as the mask appeared to assume the mastery, the development of gases which would attack organs other than the respiratory organs. In this contest the technicians of the I. G. maintained supremacy throughout, due to its well established organization. By means of this organization the Germans were able to develop and deliver at the front new gases in time periods of weeks where months would be required by any of the Allied countries.

The author describes in more or less detail the method used in each of the principal Allied countries in meeting the situation. In our own country Edgewood Arsenal was the answer, although like so many of the mammoth projects in this country, it failed to reach production in time to be of material use. The various methods adopted by the Allies were all emergency measures and entirely lacked the elasticity of the I. G., which included within its organization practically a monopoly of the organic chemical industry, whereas the Allies could only provide for the production of a few elements which might become obsolete overnight.

In pointing out the present and future menace of German chemical industry as represented by the I. G., the activity of this organization in throttling competition in Allied countries, for years prior to the war, is described. The hand of the German government is seen in these activities. Whether directly due to the desire to curb munitions production in countries with which Germany might engage in war or merely the maintenance of commercial supremacy in the organic chemical industry, the result was the same. The Allied countries had permitted themselves to become and remain dependent upon Germany for medicines, dyestuffs, etc., and therefore had not available the research organizations and production facilities to compete with the I. G.

The author enumerates difficulties in solving the riddle on account of ease with which clauses in the treaty which relate to divulging information relative to methods of production and those which relate to restriction of the production of war materials can be evaded. Chemicals for use in gas warfare are so closely allied with those for use in medicines and in dyestuffs that it would be impracticable to detect research in toxic materials. In the production perhaps only the final stage differs. The author therefore feels that, while the Krupp works may be controlled, the great I. G. remains a continual menace ready to change over at almost a moment's notice to the production of toxic materials. The only solution suggested by the author is the forcible destruction of part of the German chemical industry and the installation of corresponding facilities in other countries, maintaining, by restriction, a sort of balance. Unrestricted, the chemical monopoly will again center along the Rhine, thus permitting continuance of war preparations by the Germans without detection. These preparations will be without expense and may even be expected to pay dividends.

A. ADELMAN.

Soldier and Sailor Words and Phrases. By Edward Fraser and John Gibbons. New York: E. P. Dutton & Company. 1925. $5.00.

UPON being handed a book of this sort, the critic immediately feels that it is going to be one of the innumerable slang dictionaries of no permanent interest or value and it is a delightful surprise to find the amount of real information which is valuable not only to the military man and the student of language, but even more so to the general reader of books on the Great War.

One of the most impressive facts is that words in the slang of the British soldier which are generally taken to be meaningless or even a sort of "baby talk" are really derived from the Hindu and Arabic language which the British Army has taken up while campaigning in the Orient in the same manner that so much of the military slang of our Army has been acquired by campaigns in Cuba and the Philippines and the mobilization on our southern border. An interesting example of this comes under the heading of "khaki" which is derived from the Persian word "kak" meaning dust, the original khaki having been due to the deliberate staining of white drill uniforms with brown mud in order to lessen the visibility of an English expedition sent against the Afghans.

In addition to the slang and special language of the British Army there is a fair sprinkling taken from our own Army and always treated in a fair and sportsmanlike manner.

This volume is more than a dictionary of words and phrases since it contains many tabloid historical sketches and direct quotations of historical documents, an interesting example of which is the message broadcasted by wireless on August 4, 1914, "Admiralty to all ships. Commence hostilities at once with Germany," and in similar vein the King's message to the fleet and Lord Kitchener's letter to all soldiers in the original British Expeditionary Forces.

Under the caption of "Mad Minute" is a most interesting account of the astounding accuracy and rapidity of the British Infantry fire in the Mons Retreat which time and again stopped the onrush of overwhelming numbers of Germans.

One is somewhat surprised to find the great age of expressions generally regarded as comparatively modern, such as "Howitzer," "Sniper," etc., which in general are

explained as to origin and history, the only exception being that no origin or history is given for "batman" meaning an officer's servant.

One is much interested and surprised to find the large number of women's organizations which existed in England during the War, especially so since the authors have noted that they have only given the best known.

Much space is given to the origin of the nicknames for various regiments and a complete list of battle honors of the World War for the various regiments, is appended. An interesting note in this connection is the large number of battalions which were raised in some of the regiments, The Royal Welsh Fusiliers for example, having 42 battalions.

The authors have shown a great familiarity with their subject as well as study to secure accuracy, indicating a great sympathy for the subject.

AIKEN SIMONS.

The Sociology of Revolution. By Pitirim A. Sorokin. Philadelphia: J. B. Lippincott Company. 1925.

THIS book was written in the Szecho-Slovakian Republic where Professor Sorokin found the most hospitable refuge and friendship after banishment from Russia by the Soviet Government in October, 1922. The theories which go to make up his doctrine bear the stern imprint of the Russian Revolution, and with this in mind many of their extravagances can be better understood. In the vernacular of the day, this book is "deep stuff." So deep in fact that only those portions which one can understand by a casual reading are apt to be remembered. For sociological study the work, no doubt, contains a wealth of material and fact, but for the reader whose aim is self-instruction without a great deal of research the book is entirely too heavy.

Professor Sorokin presents an analysis of the various human factors which enter into his subject, the analysis being most comprehensive and thorough.

The startling conclusion that one must derive from perusing this book is that the long years of autocracy in Russia have been imprinted on the Russian people so deeply that their effects such as we are seeing today can well be condoned. The surprising thing about it is that a people come suddenly into freedom should go to the extremes to which that nation has. It is doubly hard for an American to get the proper visualization of such a case due principally to the fact that our own makeup is so radically different. While we have gone through revolution, rebellion and social change, the American complex is so widely different that even in the extremes it is sensible and realizes some human restraint. This observation is not made in any way as a reflection upon the people of Russia who will eventually, it is believed, find an equilibrium and will recede from their present state of chaos. Certain it is that they are blameless for their condition, and the shoulders upon whom the responsibility rests are those leaders of years back who held them under autocratic sway.

Taken in this light, Professor Sorokin's book is indeed interesting and of great value. To the average American whose mind has developed from a different basis it is a revelation both in theory and fact and brings a realization that we are indeed a fortunate people to have undergone our own development without the severe penalties which the Russian people are paying.

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The Kentucky Rifle. By Capt. John G. W. Dillin. Washington, D. C.: The American Rifle Association.

"THE Kentucky Rifle" is an original study of the origin and development of a purely American type of firearms. This book gives accurate historical data concerning the early gunsmiths in the American Colonies. The work is dedicated to "The Kentucky Rifle," legends regarding which have been innumerable. Few writers have ever given more than a passing word to this weapon which deserves a place in American history.

This book is profusely illustrated with photographic reproductions of the finest examples of the Kentucky Rifle and various other distinctly American types of rifles. A complete history of firearms is given in the foreword by Captain Wm. De V. Foulke.

Captain Dillin is well qualified to write this work, as he has for years been an authority on Kentucky rifles. Only one who has dedicated his life to such work could have accumulated the mass of information which he so interestingly gives. He describes the passing of the flintlock which was followed in turn by the passing of the muzzle-loader. The passing of the muzzle-loader shows the flintlock Kentucky as the maker of rifle history. From about 1725 to 1840, with another 100 years in snap-haunce form, the percussion principle was used, reached its zenith, and became obsolete in 50 years.

Captain Dillin describes some of the old turkey shoots in which the firing was off-hand, shooting at the head of the target at 100 yards and at the body at 200 yards. He describes a great many of the old matches which were usually at 20 yards off-hand shooting at tack heads. He gives a number of targets made with some of the old Kentucky rifles.

Captain Dillin ransacked American history for descriptions of the accuracy, range and effect of fire of some of the older American rifles. The picture he describes of rifle shooting in Revolutionary days as given by periodicals at that time is unusually interesting. Some of these extracts follow:

"* * * Two brothers in the company took a piece of board, five inches broad, and seven inches long, with a bit of white paper, about the size of a dollar, nailed in the center, and while one of them supported this board perpendicularly between his knees, the other, at the distance of upwards of sixty yards, and without any kind of rest, shot eight bullets successively through the board, and spared a brother's thighs! Another of the company held a barrel stave perpendicularly in his hand, with one edge close to his side, while one of his comrades, at the same distance, and in the manner before mentioned, shot several bullets through it, without any apprehensions of danger on either side. The spectators, appearing to be amazed at these feats, were told that there were upwards of fifty persons in the company who could do the same thing; that there was not one who could not plug 19 bullets out of 20 (as they termed it) within an inch of the head of a ten-penny nail; in short, to evince the confidence they possessed in their dexterity at these kinds of arms, some of them proposed to stand with apples on their heads, while others at the same distance undertook to shoot them off; but the people, who saw the other experiments, declined to be witnesses of this. * * *." (*Dunlap's Penn'a. Packet or The*

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General Advertiser, Monday, Aug. 28, 1775. *No.* 201. *Postscript, i. e., extra folio.*)

"August . . . Several companies of riflemen, amounting, it is said to more than 1,400 men, have arrived here from Philadelphia and Maryland, a distance of from 500 to 700 miles. They are remarkably stout and hardy men; many of them exceeding 6 feet in height. They are dressed in white frocks, or rifle shirts, and round hats. These men are remarkable for the accuracy of their aim; striking a mark with great certainty at 200 yards distance. At a review, a company of them, while on a quick advance, fired their balls into objects of 7 inches diameter, at the distance of 250 yards. They are now stationed on our lines, and their shot have frequently proved fatal to British officers and soldiers who expose themselves to view, even at more than double the distance of common musket shot." (*"Military Journal during the American Revolutionary War,"* 2d ed., 1827, pp. 33-4.)

The Pennsylvania Gazette of August 16, 1776, reported:

"We are also told that the riflemen had in one day killed ten of a reconnoitering party; and it is added likewise, that they have killed three Field officers. A sentry was killed at 250 yards distance."

"These items were promptly republished in the London papers, and excited wrath. In the British camp the riflemen were called 'shirt-tail men, with their cursed twisted guns, the most fatal widow-and-orphanmakers in the world.'" (Drake's *"Old Landmakers of Middlesex,"* 88.)

In *The Pennsylvania Gazette* of August 21st is the following item from Newport:

"A gentleman from the American camp says—'Last Wednesday, some riflemen, on Charlestown side, shot an officer of note in the ministerial service, supposed to be Major Small, or Bruce, and killed three men on board a ship at Charlestown ferry, at the distance of full half a mile.'"

"This shows that there was a good deal of ammunition wasted in reckless firing, for the round bullet of half ounce or thereabouts will not carry half that distance with precision, though General Lee probably over did the matter when he issued to Colonel Thompson the following order: 'It is a certain truth, that the enemy entertain a most fortunate apprehension of American riflemen. It is equally certain, that nothing can contribute to diminish this apprehension so infallibly as a frequent ineffectual fire. It is with some concern, therefore, that I am informed that your men have been suffered to fire at a most preposterous distance. Upon this principle I must entreat and insist that you consider it as a standing order, that not a man under your command is to fire at a greater distance than a hundred and fifty yards, at the utmost; in short, that they never fire without almost a moral certainty of hitting their object.'" (*"Correspondence of the Revolution,"* ed. Sparks, II, 501-2.)

Taken altogether, the reviewer considers this book as one which every rifleman should have in his library. There is no other book which covers this subject and even if there were, Captain Dillin's work is in a class by itself. The book is rather expensive for the income of the average rifleman, yet nevertheless it is worth more than the price.

G. P. Wilhelm.

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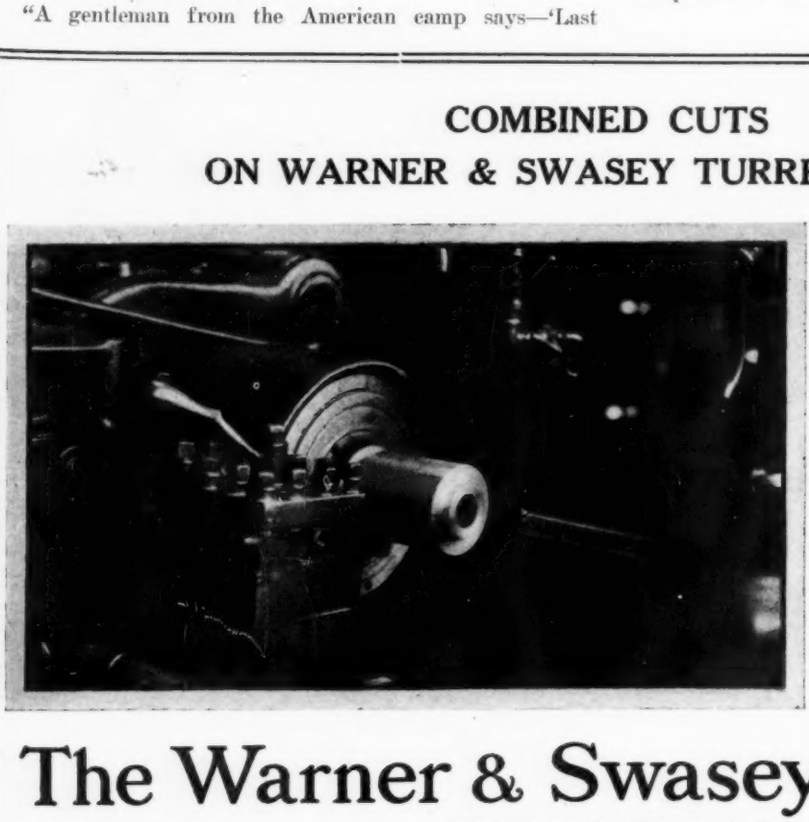

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International Economic Policies. By William Smith Culbertson. New York: D. Appleton & Co. 1925. $3.50.

THE name of former Senator William Smith Culbertson has already taken a leading place among American political economists of today. Fortified by years of study of American economic subjects, an author of repute, and a public servant of high caliber, Mr. Culbertson has gathered his reflections on our world-wide economic policy in this book just recently published.

Many of the chapters are lectures delivered before his class in the School of Foreign Service at Georgetown University and others are addresses at conferences over which he presided in 1922, 1923 and 1924 at the Institute of Polities at Williamstown, Mass.

It can be seen at a glance then that a man of such experience and training is well qualified to publish a treatise on international economic policies and Mr. Culbertson fulfills every expectation that even the most ardent student might desire. One might search far and wide for a word picture of our present economic status as it has been developed by various countries and under various conditions and not find nearly as complete a treatment as the author presents. In the first chapter of his work he discusses the background of the modern world. *Laissez-faire,* Benthamism, internationalism and international free trade movements are discussed in a brief yet thorough presentation that is worthy of repeated study by those who have not an accurate idea of the influence of these theories upon our economics of today.

There follow learned discussions of commercial treaties both from the national standpoint and the most favored international view. One might hazard the suggestion that the political viewpoint has much to do with the acceptance or rejection of Mr. Culbertson's dogmas as one either sides with or against him. Certain it is that the great majority of American people who have repeatedly expressed their approval of a protective tariff will sanction his doctrines and even his opponents must agree with his logic.

Probably the most enlightening portions of the book are those in which he discusses the divergent theories of "the Closed Door" and "the Open Door." Under the latter the historical facts divulged and the learned author's comments on them appear, to this reviewer at least, one of the enlightening pronouncements in recent times. The remainder of the book is made up of economic discussions concerning raw materials and fuels, foreign loans and investments, competition and combination in international commerce, and closes with a very learned thesis on commercial policies affecting shipping which, in relation to our apparent undetermined mercantile marine policy, might well be read by those who are responsible for its destinies. There is a very copious appendix in which the author supplements his main text with short accounts of some of the leading factors in American economics. For instance, there is a verbatim quotation of Section 317 of the Tariff Act of 1922 and a short chapter on "The Panama Canal Tolls" wherein are discussed the several treaties and the action in abrogating those provisions of law which were in direct conflict with the Hay-Pauncefote Treaty.

In conclusion, one could not state more accurately the real value of this work than has been done by a contemporary reviewer who said, "This is an important and a

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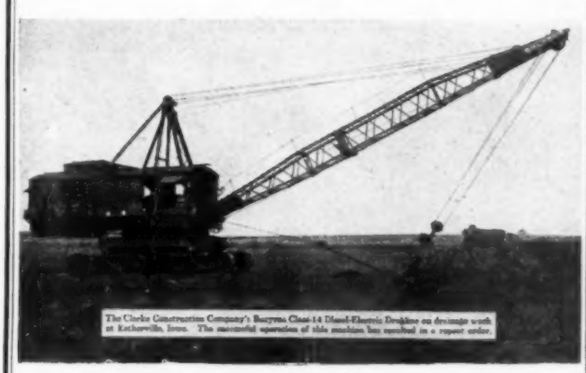

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useful work, fully documented and replete with authentic information. Those who favor *laissez-faire* in international relations will disagree even with some conclusions which Mr. Culbertson presents most persuasively and effectively; but there can be no disagreement about the solid worth of the volume. It reveals an exceptional grasp of world political patterns and motives, and it is temperate in its treatment of them. It might well be made a handbook in our State Department, and studied by every American outpost in a foreign field, commercial, industrial and financial as well as official."

J. R. Dove.

Vauban: Builder of Fortresses. By Daniel Halevy. New York: The Dial Press. 1925. $2.75.

ENTERING the military service of France in 1651 at the age of 17, ten years before the Renaissance received its greatest impetus when Louis XIV succeeded to the throne, Vauban, builder of French fortresses that have been the marvel of military engineers even to this day, began his great services to his native land. St. Simon has characterized him at this period of his life as a typical country squire of Burgundy and of his ancestry, "nothing could be shorter, newer, duller, of less importance."

The forty-five years of his active military service which followed stand unsurpassed in prominent accomplishments and in point of service by any other tactician or engineer of any country. It is unnecessary here to recount in detail the almost superhuman record of accomplishment which he rendered. Suffice it to say that the great fortresses of France and Flanders, many of which still stand, are their own proof of the ability and skill of this great engineer. Were his capabilities confined to the engineering field only his record would be in itself a most worthy one. Add to it his position as a marshal of France, commander-in-chief of the French armies, which, at an advanced age, he led through Flanders to Dunkirk, and you have the military life and history of a leading figure of all time.

Sincere and adamant in his conviction, the only possible flaw one might find in his entire career might be the publication of his *Dixme Royale* against the express wish of the King and the States General. This was done after he had returned from a victorious campaign and when the doctrines of the *Dixme Royale* were greatly needed by France. Possibly had the champion of his work been present to defend it it might in the long run have forestalled the great catastrophe of the French Revolution.

It can be seen then that this book is of tremendous significance to those whose interest lies, particularly in military science, in a narrative of the life work of a leader whose record will not be dimmed by the passage of time. The telling of the story has been admirably handled by Mr. Daniel Halevy, the thoroughness of whose researches are apparent throughout the work. He is entitled to a great deal of credit and we hope to be pardoned if the remark be inappropriate but congratulations are also due Mr. Lincoln MacVeagh, the publisher, who has brought out a work which in matter and form is superb.

L. A. Codd.